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ORIGINAL ARTICLES

OBSERVATIONS ON THE FORM OF THE DENTAL ARCH OF THE ORANG*

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THE prevailing notion regarding the conformation of the dental arch of the anthropoid ape appears to be so thoroughly settled in the minds of many scientists that it would seem an imposition for any one to attempt a reiteration of facts so widely known and generally accepted. Superposing this thought with the idea that what is contained in the present contribution is somewhat at variance with what has hitherto been advanced, it becomes a rather delicate task for one who considers himself not fully qualified to speak authoritatively on the subject of anthropology. It is, therefore, my intention to submit these observations with a feeling of reserve, confining myself to a description of the actual facts observed and claiming no epoch-making discoveries in the endeavor to contribute something that may aid in the correction of some of the numerous errors that befog our views in the perception of the truth.

Especially, is it necessary now to rouse no undue expectations by advancing any theories or making final deductions, as this is but the beginning of an investigation which will extend through the entire anthropoid family, when, with more extensive data on hand and more matured judgment, it will be reasonable to expect some definite conclusions.

The present task involves a description of the phenomena observed in connection with the form of the dental arch of the orang, omitting all attempts of any interpretations, but aiming mainly to answer the following questions:

1. Does the dental arch of the orang conform to the outline as described by various authorities?

2. Is the "diastema" in the orang dentition a phenomenon similar to that appearing in some lower forms?

*Read at the meeting of the New York Academy of Sciences held in May, 1917, at the American Museum of Natural History, New York, N. Y.

3. Is the labidonty or edge-to-edge bite an exclusively pithecoid characteristic?

1. DOES THE DENTAL ARCH OF THE ORANG CONFORM TO THE OUTLINE DESCRIBED BY VARIOUS AUTHORITIES?

Tomes, De Terra, Selenka, and various other authorities concur with the idea that the dental arch form of "the most anthropomorphous apes" differs from that of man, in that "the teeth instead of being arranged in a sweeping curve, the jaws are squarish, the incisors being arranged in something approaching a straight line between the outstanding canines, behind which the premolar and molar series run in straight lines, converging somewhat as they go backward." (Tomes.)

On the examination of the collection numbering eighty-three orang skulls at the National Museum, Washington, D. C., comprising those gathered by W. L. Abbott, the outlines assumed by the dental arches in this ape were found to conform to five different configurations, these forms being determined mainly by the mode of arrangement of the premolar-molar series. The incisors and canines in all these forms coincide with Gregory's description, as forming "an evenly rounded or arched series." The outlines to which the dental arches were found to conform may conveniently be described as follows (see Table I):

Pyriform	U-shaped	Divergent	O-shaped	Saddle-Shaped
				
36	54	24	17	37

Table I.—Table showing the various forms which the dental arches in the orang assume and frequency of their occurrence. For the sake of simplicity the figures representing these forms will hereafter be referred to by letters. Thus, pyriform, P; U-shaped, U; divergent, D; O-shaped, O; and saddle-shaped, S.

1. The pyriform arch, in which the widest dimensions are in the first premolar region, thereafter the buccal teeth, arranged in straight or nearly straight lines, converge posteriorly. (Fig. 1-*A* and *B*.)

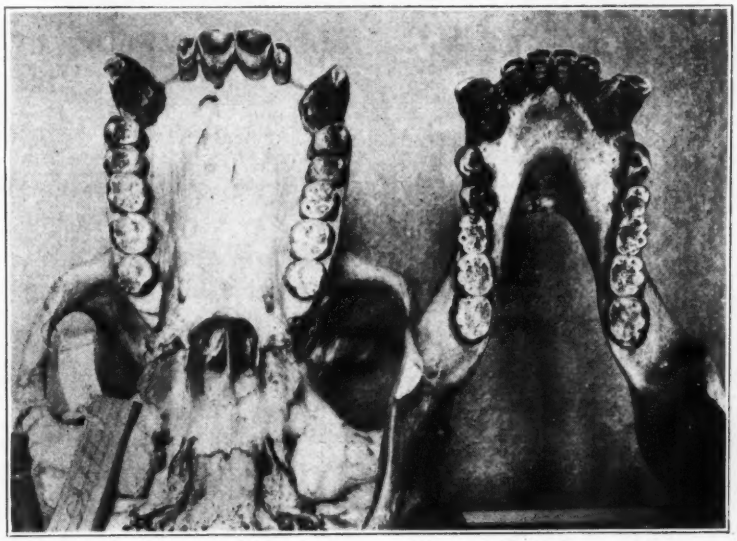
2. The U-shaped arch, in which the premolar-molar series are arranged in straight lines parallel to each other. (Fig. 2-*A*.)

3. The diverging arch, in which the premolar-molar series are arranged in straight or nearly straight lines diverging as they proceed backward. (Figs. 3-*A* and *B*, 4-*B*.)

4. The O-shaped or oval arch, in which the premolar-molar series are arranged in curved lines with the convexity toward the cheek. (Fig. 4-*A*) and

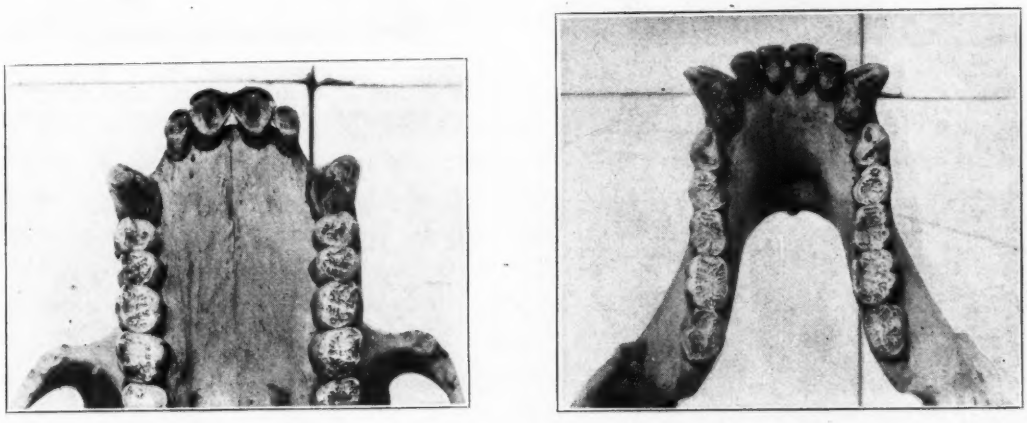
5. The saddle-shaped arch, in which the premolar-molar series are arranged in curves with the convexity toward the tongue. (Fig. 5-*A* and *B*, and Fig. 2-*B*.)

The general outline of these forms though perceptible to the eye, on visual observation, were, nevertheless, determined by accurate measurements taken as follows: The width between the two sides of the mouth was obtained by measuring the distance between the premolar-molar series of either side using the cusps of the teeth in the lower jaw and the fossæ of the teeth in the upper, as starting points; thus in the lower jaw the distances between the two sides of the premolar-molar series were measured at the cusp points of the buccal cusps of the pre-



A. *B.*

Fig. 1.—Occlusal view of upper (*A*) and lower (*B*) jaws of male orang showing pyriform type of dental arches. X ⅓.

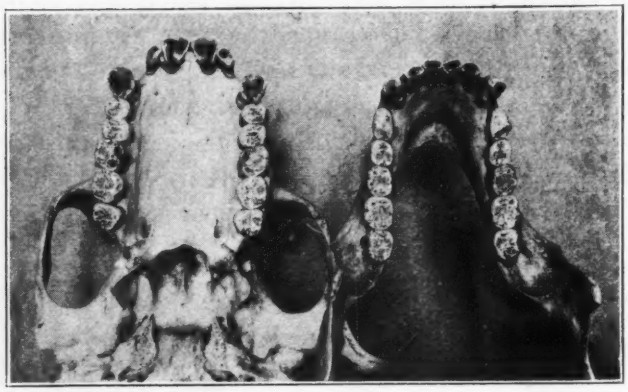


A. *B.*

Fig. 2.—Occlusal view of upper (*A*) and lower (*B*) jaws of male orang showing U-shaped upper and saddle-shaped lower dental arches of the same animal.

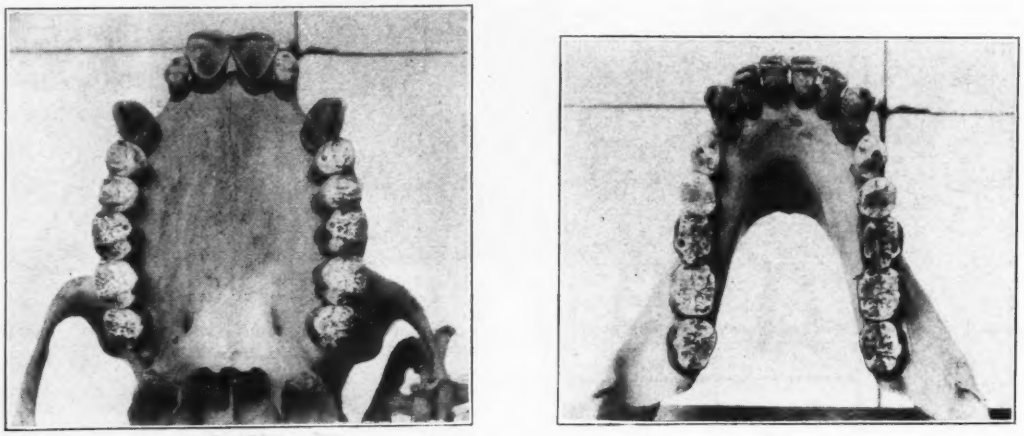
molars, and the cusp points of the disto-buccal cusps of the molars. In the upper the measurements were taken between the depressions in the occlusal surfaces of the premolars and molars accomodating the cusp points mentioned of the lower teeth.

These forms though exhibited by both the upper as well as the lower dental



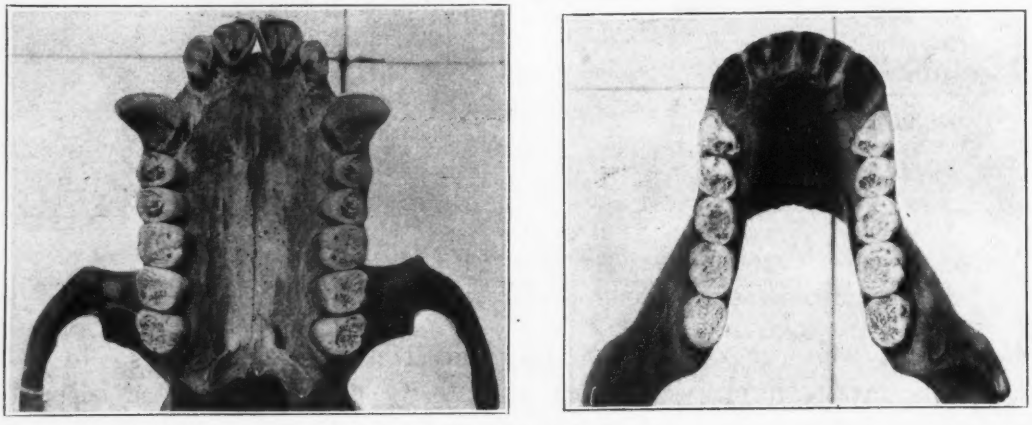
A. *B.*

Fig. 3.—Occlusal view of upper (*A*) and lower (*B*) jaws of female orang showing the divergent form in both dental arches.



A. *B.*

Fig. 4.—Occlusal view of upper (*A*) and lower (*B*) jaws of female orang showing O-shaped form in the upper and the divergent in the lower dental arch of the same animal.



A. *B.*

Fig. 5.—Occlusal view of upper (*A*) and lower (*B*) jaws of male orang showing the saddle-shape in both the upper and lower dental arches, the upper being somewhat less accentuated than the lower.

arches are not necessarily found to be alike in both jaws of the same individual. They may appear in harmonious relationship, as in Figs. 1, 3, and 5, but more often the two dental arches of one individual are independent in form, as in Figs. 2 and 4. Table II shows the frequency with which these forms appear in the upper and lower jaws.

TABLE II

FREQUENCY WITH WHICH THE VARIOUS ARCH FORMS APPEAR IN THE UPPER AND LOWER JAWS*

Form of Dental Arch	P	U	D	O	S
Upper	32	24	9	17	1
Lower	4	30	15	0	26

*The letters in the top row indicate the form of arch, thus: P, pyriform; U, U-shaped; D, divergent; O, O-shaped; and S, saddle-shaped.

Thus, it may be deduced from Table II that while the pyriform arch appears in the upper jaw in the proportion of 8:1 as compared with its frequency in the lower, the O-shaped arch is exclusively prevalent in the upper. The U-shaped arch, on the other hand, is about equally divided between the two jaws, while the saddle-shaped arch is almost entirely confined to the lower, the divergent type being in the proportion of 5:3 in favor of the lower.

TABLE III

DISTRIBUTION AND FREQUENCY OF THE VARIOUS ARCH FORMS AS THEY APPEAR IN THE TWO SEXES*

Form	P		U		D		O		S	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Upper	24	8	14	9	1	8	2	15	1	0
Lower	4	0	15	15	5	9	0	0	17	10

*The letters in the top row indicate the forms as follows: P, pyriform; U, U-shaped; D, divergent; O, O-shaped; and S, saddle-shaped.

Though these forms are not exclusively characteristic of sex distinction, yet as may be observed in Table III, there is a slight preponderance of certain arch forms in each sex. Thus in the upper jaw the pyriform and U-shaped arch form seems to be predominant in the male, while the divergent and O-shaped form is found more frequently in the female. In the lower jaw, on the other hand, the pyriform is possessed by the male exclusively, while the divergent is in excess in the female, the U- and O-shaped being equally divided in both sexes and the saddle-shaped favored by the male.

If the dental arches as they appear in their relationship to one another be now examined, the variety of their possible combination will be found quite large. The combination most frequently observed as may be seen in Table IV is the pyriform upper with the saddle-shaped lower, appearing fifteen times. The combinations following this in frequency are the U-Shaped upper with the U-shaped lower, the pyriform upper with the U-shaped lower and the O-shaped upper appearing in equal numbers with the U-shaped and diverging lower. The remaining combinations are rather small and widely distributed.

On taking the sex factor into consideration (see Table V) the male element will be found to be more closely associated with the combinations of the pyriform

TABLE IV

SHOWING IN WHAT COMBINATION AND FREQUENCY THE ARCH FORMS APPEAR IN ONE INDIVIDUAL*

Combination of arch forms (Upper / Lower)	P/P	P/U	P/D	P/O	P/S
Frequency of each combination	3	10	3	0	15
Combination of arch forms (Upper / Lower)	U/P	U/U	U/D	U/O	U/S
Frequency of each combination	0	11	4	0	5
Combination of arch forms (Upper / Lower)	D/P	D/U	D/D	D/O	D/S
Frequency of each combination	0	3	2	0	4
Combination of arch forms (Upper / Lower)	O/P	O/U	O/D	O/O	O/S
Frequency of each combination	1	6	6	0	2
Combination of arch forms (Upper / Lower)	S/P	S/U	S/D	S/O	S/S
Frequency of each combination	0	0	0	0	1

*Letters in two upper rows indicate forms of arch. P, pyriform; U, U-shaped; D, divergent; O, O-shaped; S, saddle-shaped. Each square containing the letters represents a combination as it appears in one individual; the letter above indicating the form of the upper arch, and the letter below that of the lower arch.

TABLE V

SHOWING IN WHAT COMBINATION AND FREQUENCY THE DENTAL ARCH FORMS APPEAR IN ONE INDIVIDUAL OF EACH SEX*

Combination of arch forms (Upper / Lower)	P/P	P/U	P/D	P/O	P/S
Sex	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Frequency of combination	3 0	7 3	1 1	0 0	11 4
Combination of arch forms (Upper / Lower)	U/P	U/U	U/D	U/O	U/S
Sex	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Frequency of combination	0 0	5 6	2 2	0 0	4 1
Combination of arch forms (Upper / Lower)	D/P	D/U	D/D	D/O	D/S
Sex	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Frequency of combination	0 0	1 2	1 1	0 0	0 4
Combination of arch forms (Upper / Lower)	O/P	O/U	O/D	O/O	O/S
Sex	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Frequency of combination	0 0	1 5	1 6	0 0	0 2
Combination of arch forms (Upper / Lower)	S/P	S/U	S/D	S/O	S/S
Sex	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Frequency of combination	0 0	0 0	0 0	0 0	1 0

*The letters in the top square indicate the forms of arch. P, pyriform; U, U-shaped; D, divergent; O, O-shaped; S, saddle-shaped. Each square containing two letters represents one combination as it appears in one individual; the letter above indicates the form of the upper arch and the letter below, that of the lower arch.

upper with the pyriform, U-shaped and saddle-shaped lower, and the U-shaped upper with the saddle-shaped lower. The female, again, gains an advantage over the male in the combinations of the O-shaped upper with the U-shaped diverging and saddle-shaped lower, the diverging upper with the saddle-shaped lower. The other combinations are more equally distributed between the sexes.

2. IS THE "DIASTEMA" IN THE ORANG DENTITION A PHENOMENON SIMILAR TO THAT FOUND IN LOWER FORMS?

"There is a 'diastema' or interval in front of the upper canine into which the point of the lower canine passes when the mouth is closed." (Tomes.)

The term "diastema," of course, is understood to convey the idea of an inter-

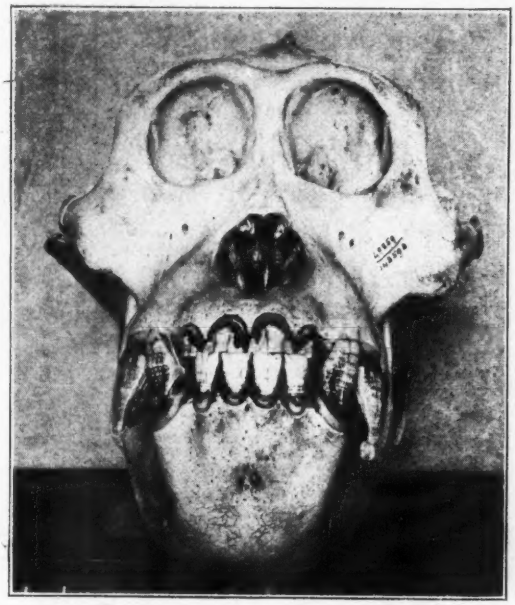


Fig. 6.—Front view of male orang, showing the mechanical juxtaposition of the canine teeth within the spaces or "diastemas" allotted for them.

val or interruption in the continuity of the dental series. If the dentition of the horse be considered, the diastema would be in manifestation, whether the jaws be in apposition or apart. If we, however, consider the orang masticatory apparatus as a whole, with the teeth in occlusion, as in Fig. 6, we could hardly place the diastema of the orang dentition in the same category as that of the horse; for, the space in each jaw is completely occupied by the mechanical juxtaposition of the canines when the jaws are closed. The diastema in the orang dentition may, therefore, be said to be an anatomic provision for the accommodation of the crowns of the opposing canine teeth *in toto* or in part. It is, consequently, not a space between the teeth in the sense that it occurs in the horse dentition, but rather an anatomic adaptation due to mechanical accommodation.

Moreover, the "diastema" besides presenting a break in the continuity of the crowns in the tooth series of each jaw separately, it also indicates the ex-

istence of a bony structure produced as an accompanying factor, of the interval existing between the teeth; namely, the enormously thick septum intervening between the root of the canine and that of the second incisor in the upper jaw and the roots of the first premolar and canine in the lower jaw. The range of variation in the thickness of this septum is from about 1 mm. to 13 mm. in the upper, and from 0.2 to 6 mm. in the lower. So far as was possible to determine, no correlation between this bony septum and the size of the canines, or the size and form of the dental arch was found to exist. It may, however, have some connection with the form, position, and functional activity of the opposing canine teeth. This probability will have to be verified by further studies and observation of the dentitions of this as well as the other genera in the anthropoid family.

The fact of the alveolar process being but a transient structure, coming and going with the teeth, the differences in size of this septum on the two sides

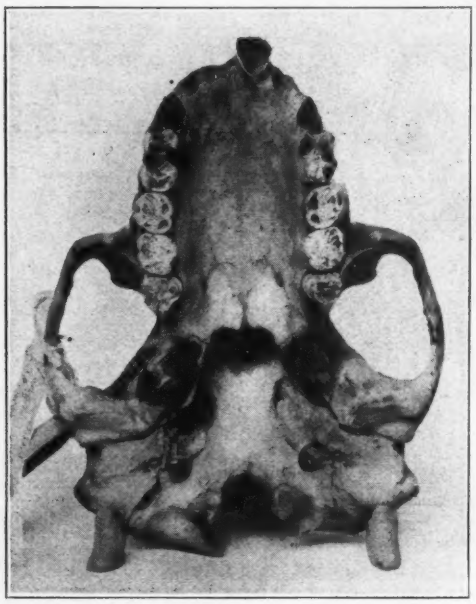


Fig. 7.

Fig. 8.

Fig. 7.—Occlusal view of upper jaw of orang (153818), showing considerable decrease in thickness of the septum anterior to the right canine sockets due to loss of lower right canine.

Fig. 8.—Occlusal view of lower jaw of same specimen as Fig. 7, showing diminution of space where the teeth were lost as compared with the normal side, also forward shifting of lower molars on injured side.

of the same dental arch where the wear of the canines is unequal, would verify the idea that this bony septum, like the rest of the osseous tissues, is subject to mechanical conditions; its bulk being increased or diminished by the mechanical influence of the opposing canines during functional activity. In proportion as this influence decreases or disappears, the thickness of the septum will diminish. An illustrative instance was observed in the specimen No. 153818 (Fig. 7). The upper left septum measures 6.3 mm., while the thickness of the right is only 3 mm. The reason for this difference was found to be due to the absence of the lower right canine, which must have been lost through some accident together with both lower premolars on that side (Fig. 8). The alveolar process of the lower jaw in that region is entirely absorbed and the distance from

the second incisor to the first molar measures 26 mm., while the homologous distance on the opposite side with the canine and premolars *in situ* measures 35 mm. It may be seen, then, that there is a decrease of 9 mm. between the second incisor and first molar of the injured side as compared with the normal one, and also that owing to the loss of these teeth, the loss of their mechanical influence upon the upper teeth brought about a decrease in the thickness of the bony septum in front of the upper right canine to the extent of 3.3 mm.

In man these conditions are variously brought to our notice by certain dis-

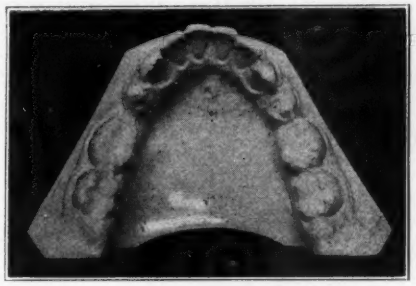


Fig. 9.

Fig. 10.

Fig. 9.—Occlusal view of cast of human lower dentition, showing lack of second premolars. The space for the right tooth is entirely obliterated while the left is partly visible.

Fig. 10.—Occlusal view of case of lower dentition of the same individual as Fig. 9, after the spaces for the missing teeth have been restored. The left premolar erupted and assumed its position, while the right tooth germ being absent, bone developed in the interstice to fill in the distance between the roots of the first molar and first premolar.

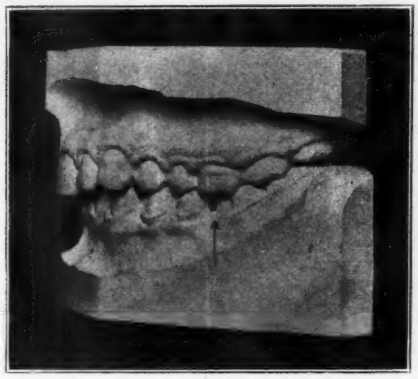


Fig. 11.—Side view of cast of human dentition showing lack of space between the second lower premolar and second lower molar, the first molar having been lost at an early age. The lower first molar on the right side measures 10 mm., while the space on the left side measures less than 1 mm.

turbances in development and by processes of disease. Thus, Fig. 9 represents a cast of a lower dental arch and alveolar process of an individual in which the second premolars failed to erupt. As a consequence the alveolar process destined to hold that tooth in position, failed to develop. Upon the application of mechanical stress, by means of orthodontic appliances, a space was artificially made to the extent necessary for the accommodation of the missing tooth on either side. The tooth on the left side erupted and the alveolar process developed around it. On the right side of the same jaw, although the same process for

the restoration of space was resorted to, no tooth erupted, there having been no dental germ present; but bone, nevertheless, developed to fill the gap between the roots of the separated teeth. (See Fig. 10.) The reverse phenomenon may be seen in another case (Fig. 11), where the alveolar process had developed, but owing to the loss of the first permanent molar, it disappeared again, allowing the second molar to take its position adjoining the second premolar.

If the skull of a young orang (Fig. 12) be examined before the teeth have erupted, there will be no marked differences noticed in the thickness of the septa separating the various tooth crypts. But when the deciduous dentition is fully developed, as in Fig. 13, these differences become manifest. This fact demonstrates again that the bony septa increase in thickness after the functional activity of the canines is becoming effective.

It is, therefore, quite plain that although in the orang dentition a diastema does exist, it is a manifestation of mechanical conditions brought about by the

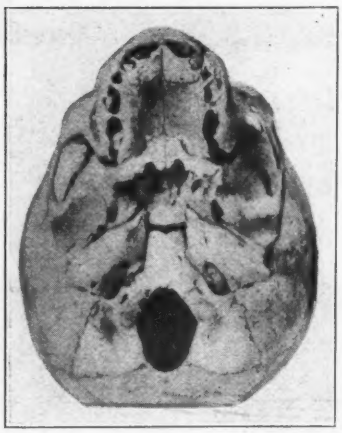


Fig. 12.

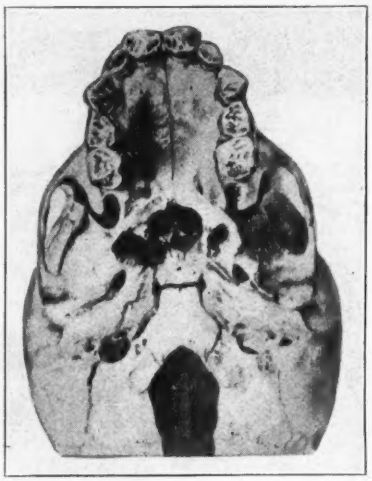


Fig. 13.

Fig. 12.—Occlusal view of upper jaw of young orang with the teeth in their crypts but quite ready for eruption. Notice lack of marked difference in thickness of the various septa. (After Selenka.)

Fig. 13.—Occlusal view of upper jaw of young orang with deciduous dentition fully developed, showing the appearance of a small "diastema." (After Selenka.)

canines during their development and functional activity, and must be regarded in a sense different than the diastema of other forms, as those, for instance, of the ungulates.

IS LABIDONTY OR EDGE-TO-EDGE BITE A PITHECOID CHARACTERISTIC?

"Also the 'articulation' in the ape appears in a form which Welcker called labidonty." (De Terra.)

Of the fifty-one specimens with the incisors *in situ,* thirty-six showed an edge-to-edge occlusion, and fifteen had a decided overbite. The edge-to-edge occlusion is well illustrated in Fig. 14. The extent of the overbite occlusion ranged from slight lapping of the upper incisors over the lower, to a considerable projection of the upper anterior teeth, as presented in Fig. 15.

Upon the examination of more than two thousand Indian skulls, both in this

institution (The American Museum of Natural History, New York) and at the U. S. National Museum, Washington, the best Indian dentures presented an edge-to-edge relation of the anterior teeth, as in Figs. 16 and 17 (Delaware Indian). In these Indian dentitions, as well as in those of the ape showing an edge-to-edge bite, there is evidence of excessive wear of the teeth, caused evidently by vigorous use of the jaws and also probably due to the trituration of coarse food substances. The examination of two hundred Mongolian skulls, on the other hand, revealed the prevalence of an excessive overbite in the incisor

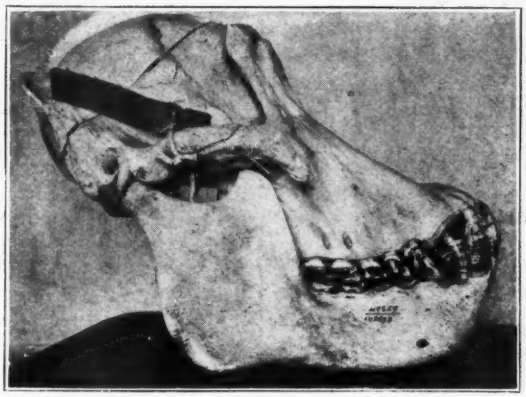


Fig. 14.—Side view of orang skull showing edge-to-edge bite of the incisor teeth.

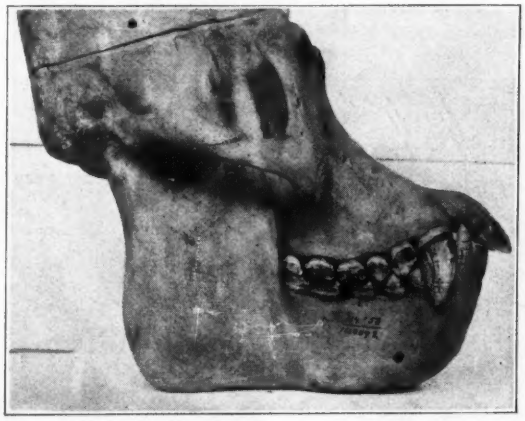


Fig. 15.—Side view of orang skull showing overbite in incisor region.

region. (See Figs. 18 and 19, Mongolian, Urga.) As I am informed by Dr. Moore, of the U. S. National Museum, the Indian skulls exhibit a shallow broad glenoid fossa, which accommodates the oval articular process of the mandible, allowing a free movement of jaw during the act of mastication; while in the Mongolian, as I have observed, the fossa is deep and the articular process is narrow, allowing probably a more limited lateral movement of the jaw.

That these explanations are not applicable to the orang temporomandibular articulation is quite certain, for in the orang "the glenoids are 'rather universally' broad and shallow." (Hrdlicka). The wear of the incisors is, therefore, equally excessive in both the edge-to-edge and the overbite dentitions. The fact, how-

ever, remains that in the Indian dentition the percentage of the edge-to-edge relationship of the incisors is very high. If it is a pithecoid characteristic, as suggested by various authorities, it has been inherited by man to a marked degree.

Fig. 16.

Fig. 17.

Fig. 16.—Front view of Indian skull, showing edge-to-edge occlusion of the anterior teeth.
Fig. 17.—Right side view of Indian skull of Fig. 16, showing to better advantage the edge-to-edge relationship of the front teeth.

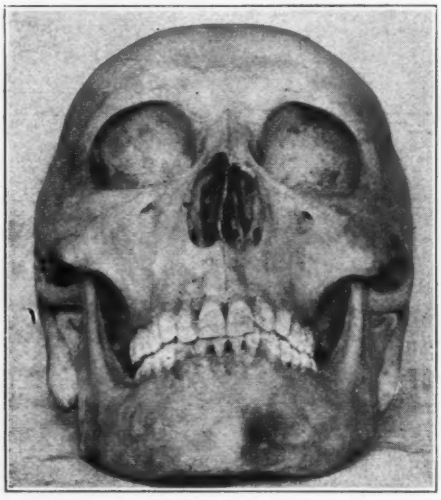


Fig. 18.

Fig. 19.

Fig. 18.—Front view of Mongolian skull, showing excessive over-bite in the incisor region.
Fig. 19.—Left side view of Mongolian skull of Fig. 18, illustrating the same point.

So far as this investigation has been conducted, it has revealed the following facts:

1. The orang dental arch is not uniform in outline, as described by various authorities, but may be divided into five typical forms, as pointed out above.

2. Although the diastema is described as an interval occurring between the crowns of certain teeth in the dental arch, it has underlying this manifestation, a bony structure, *the root septum,* the dimensions of which are subject to the mechanical conditions brought about by developmental influences and the functional activities of the canines.

3. Though the edge-to-edge bite of the incisors is prevalent in the orang, it is not an exclusive characteristic, and may be found to exist in the Indian dentition to an equally high degree, while the overbite relationship is also of frequent occurrence in the ape.

In conclusion I wish to express my thanks and gratitude to Prof. Holmes, Dr. Hrdlicka, Dr. Miller, and Dr. Moore, of the U. S. National Museum, Washington, D. C., for their kindness and interest shown me during the course of this investigation, and to Dr. Gregory of this museum for various courtesies shown me.

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PHOTO-SURVEYS OF THE HUMAN DENTURE*

By Rudolph L. Hanau, Pittsburgh, Pa.

Consulting Dental Engineer

On previous occasions, it has been my privilege to acquaint the dental profession with some of my work in dental engineering, the new science allying itself with practical orthodontics which will give it preciseness in investigation, accuracy in the interpretation of working plans, and methodical, logical, and legitimate lines of thought and work, which *must* lead to definite results, such as modern engineering demands and determines.

It is no longer necessary to point out to medical men the advantage of roentgenograms. They show us things which the naked eye can not discover. The same is true of orthophotographs.

Dr. Lowe J. Young in his paper, read before the First District Dental Society, S., N. Y., says:

"The first aim of a true professional should be to serve his clientele in the best possible manner."

Patients are to enjoy, primarily, the benefit of specialized training, and are given the treatment they need, which is not, necessarily, what they themselves most desire nor what suits our convenience.

If it is the practitioner's purpose to conform to the aim stated above, he can do justice to himself, to his patients, and to his profession, *only* if he keeps pace with the progress of his profession by making intelligent use of all means—educational and physical,—thereby raising his work to the highest possible standard.

It has not yet been generally acknowledged that orthophotography is one of the aids which will enable orthodontists to do more comprehensive, and consequently, better work.

I shall endeavor to prove that orthophotographs, or photo-surveys, as I prefer to call them, are an absolute necessity to orthodontists, as much so as are plaster casts.

The one supplements the other. Especially would I suggest that students,—and those not yet fully versed in the art of reading and using photo-surveys, always make use of both the plaster cast and the photo-survey in their work.

The orthophotographic apparatus consists, substantially, of a photographic camera and a condenser lens, (or lens combination) placed between the camera and the object to be surveyed. The focus of the condenser should be about the center of the camera lens, so that all rays from the negative plate to the condenser are deflected by the condenser to continue in parallel rays on the object side of the condenser. The entire combination is illustrated in Fig. 1.

Figs. 2 and 3 show photo-surveys of an upper and a lower arch. Surveys made by the mechanical surveying apparatus proved impracticable to a certain

*Read before the Seventeenth Annual Meeting of the American Society of Orthodontists, Excelsior Springs, Mo., Sept. 6, 1917.

degree, because their production consumes a great deal of time, and also because they are read with difficulty by orthodontists in general.*

The photo-surveys (Figs. 2 and 3) picture the denture in a form familiar to all of us; photographs showing every detail,—cusps, fossæ, gum lines, etc. They possess all the advantages of a photograph, and incorporate the refined properties of the old point-method survey. Measurements at different depths of the denture may be made directly on a scale which is photographed with the plaster cast.† The photo-surveys may be made to any desired scale. Enlargements are urged for investigation and research work.

Measurements are made with the aid of dividers.

The use of the microscope has been advocated for making measurements directly on the plaster cast. For various reasons this method must be considered fallacious.

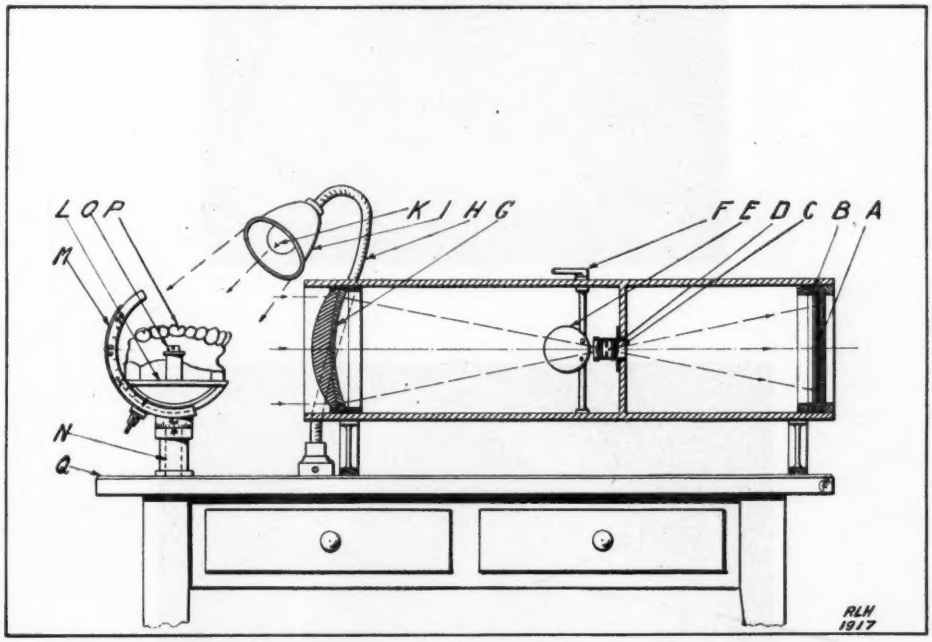


Fig. 1.—Orthophotographic apparatus. *A*, negative plate or film in *B*, an ordinary plate holder; *C*, photographic lens combination; *D*, aperture; *E*, exposure disk; *F*, handle and shaft operating *E*; *G*, condenser lens combination; *H*, adjustable light holder (two required); *I*, reflector; *K*, light (two required); *L*, platform adjustable on *M*, segment, and *N*, pivot; *O*, vise attachment (two required) to hold *P*, the object to be surveyed; *Q*, table or board to which the entire combination may be rigidly attached.

Excellent results are attained when the outlines of teeth, fossæ, cusps, etc., of both the upper and the lower denture are traced, brought into proper correlation, and printed on mat photographic paper.

On such print, the teeth of the upper and the lower jaw, appear in white on a dark background. Lines and points belonging to one jaw are differentiated from those of the other by various-colored pencil or ink lines.

In some of my work I used celluloid films instead of tracing cloth. A photographic contact print or enlargement was made directly upon the films. The lines and points of interest were marked on the film with India ink. Then the

*The reader is referred to a carefully plotted survey illustrated in the JOURNAL, Nov., 1917, iii, 652.
†See the JOURNAL, Nov., 1917, iii, 654.

film was washed in a bath especially prepared for eliminating the photographic print, the India ink remaining upon the film. The result was a perfectly transparent survey, which could effectually be brought into proper relation with the mating jaw, or with surveys of the same jaw, in its various phases of treatment.

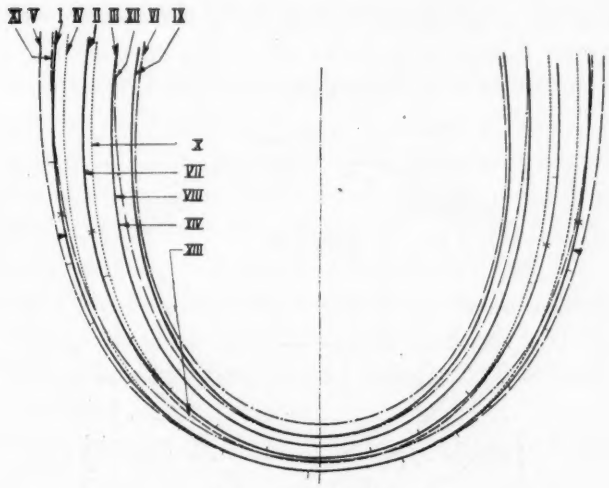
For a given set of teeth there exists not only one arch form which complies with our known rules of occlusion, but an indefinite number of them. The factors influencing the arch form, have already been presented to you on previous occasions.

Fig. 2.

Fig. 3.

If only one form existed, it would be a matter of mere chance for any one man to predetermine it.

That means we should endeavor to reconstruct that arch form which most likely will conform to given conditions. This predetermined arch form is subject to changes because we are limited to a great extent in making accurate measurements. *If we were able to introduce absolutely correct measurements (which we can not do) and had absolute and full knowledge of all requirements that make occlusion and mastication perfect (which is not the case),* then we would be able to reconstruct an arch form best suited for a given set of teeth



DENTAL CURVES

CURVES	UPPER	LOWER
BUCCAL CUSP	I	XII
FOSSAE	II	VIII
LINGUAL CUSP	III	IX
COMPENSATING CONTACT	IV	X
OUTER GUM	V	XI
INNER GUM	VI	XII
OUTER CURVE OF OCCLUSIAL CONTACT	XIII	
INNER CURVE OF OCCLLUSIAL CONTACT	XIV	

Fig. 4.

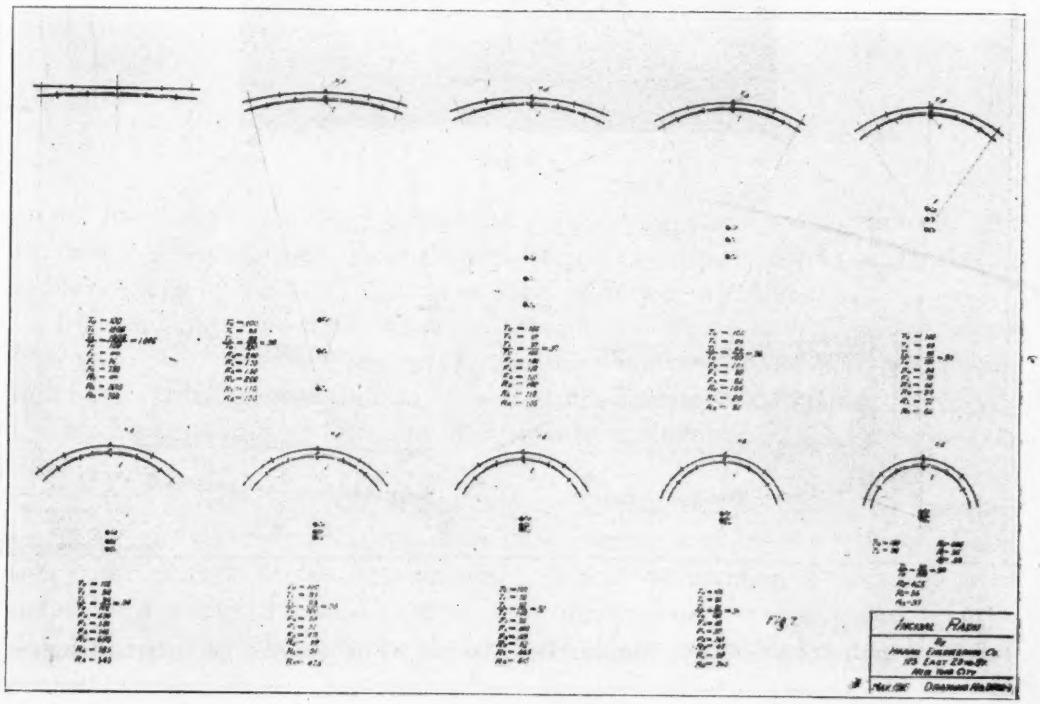


Fig. 5.

in the mouth. Whether such an arch form is the one nature intended, can hardly be claimed.

At your last convention in Pittsburgh, I read a paper that pointed out the

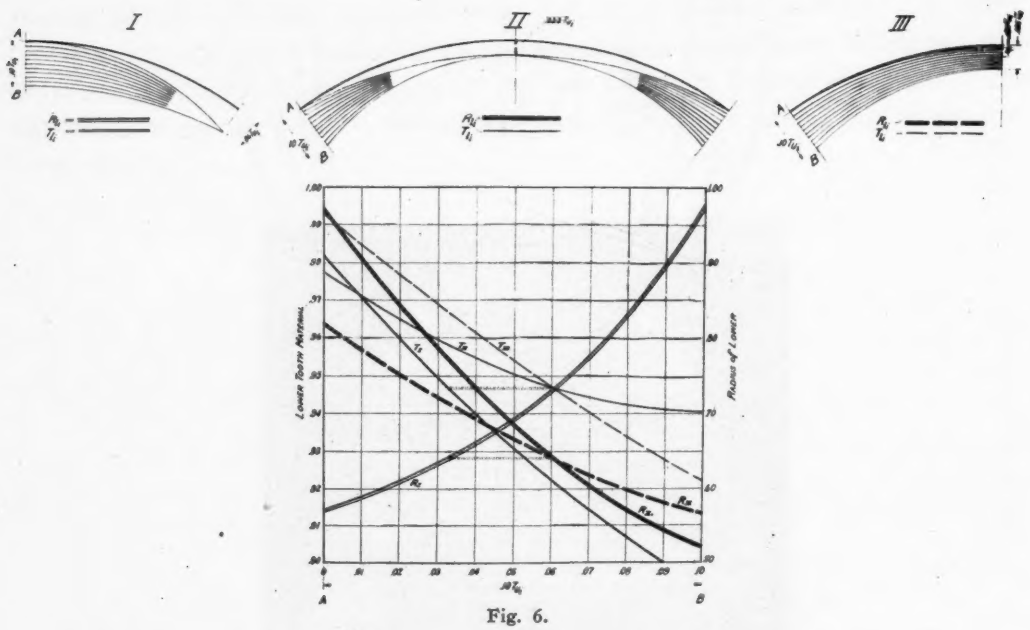


Fig. 6.

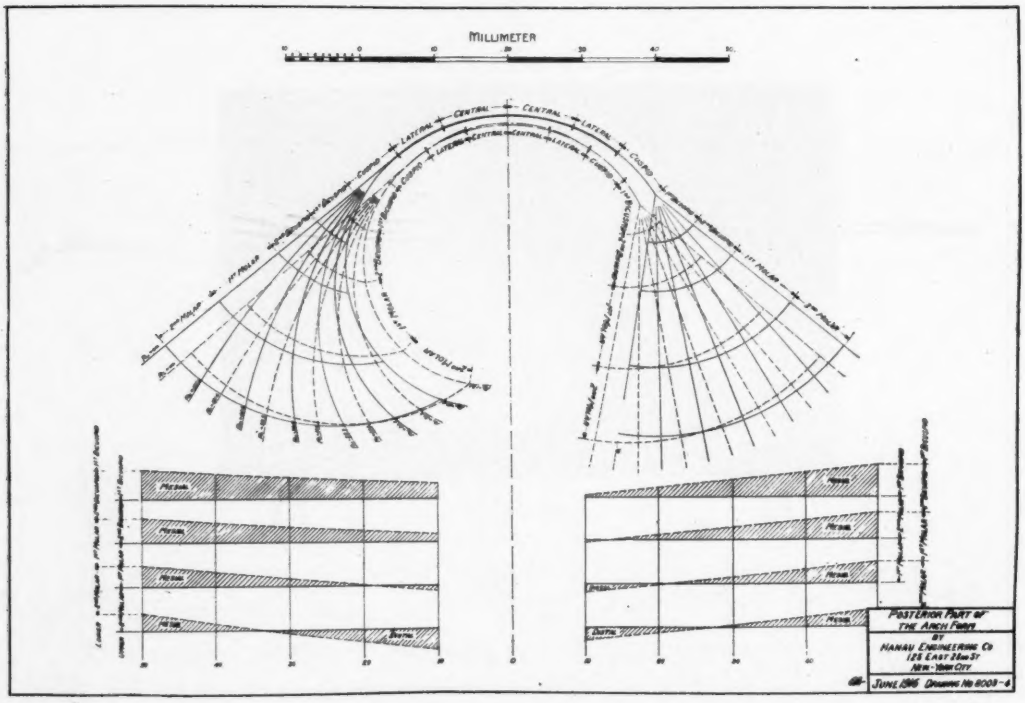


Fig. 7.

fallacy which considers the human arch forms to be similar geometrical figures such as the Bonwill or Hawley arch forms represent. With regret, I learned that it has not yet been possible to put my findings into print so that it may be

accessible to the profession as a whole.* Permit me to refresh your memory by showing a few illustrations which are an integral part of that paper, and are of particular interest in connection with this article.

It was pointed out that there exists a harmonious relation between dental curves (Fig. 4) where occlusion prevails. *This harmony immediately disappears on the survey of a denture in malocclusion.* Fig. 5 recalls the change of the radii of curvature for a change of the incisal ratio of the tooth material but constant labio-lingual distances of the C. C. Curves.

Fig. 6 illustrates the relationship of the lower tooth material and the labio-lingual distances to a given upper tooth material on a given U. C. C. Curve.

Those who have been searching for the solution of the problem of the over-bite will find the answer in this figure.

Fig. 7 is a representation of the mesio-distal relation of points on the C. C.

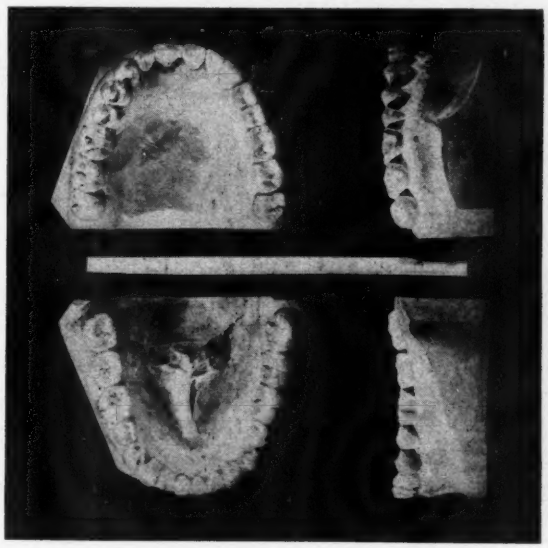


Fig. 8.

Curves for different radii of curvatures but for the same tooth material. At one time a sudden change in the cuspal region is considered and at another a gradual change of the C. C. Curves in their posterior extensions.

Fig. 8 is introduced to illustrate an ordinary photo-survey; cuspal views of the upper and lower arch, as well as the left side elevations of both are shown. Attention is called to the more rapid rise of the compensating contact curve (C. C. C.); this is due to smaller radii of curvature of the upper C. C. C. in the side elevation.

It is exceedingly difficult, if not impossible with the naked eye *to compare the radius of curvature of a concavity with that of a convexity. On a photo-survey, the magnitude can be measured.* It may be mentioned that the lower buccal cusp curve (L.B.C.C.) and the upper compensating contact curve (U.C.C.C.) in the molar and cuspal region are almost equidistant curves in space.

The upper buccal cusp curve (U.B.C.C.) rises at its posterior end to, and

*See the JOURNAL, Nov., 1917, iii, 635.

even above, the U. C. C. C. This is due to the increasing buccal inclination of the molar crowns posteriorly.

I particularly point to these characteristic forms, which already are familiar to you, because they can be measured and recorded on the photo-survey. The value of records need not be emphasized; they speak for themselves.

Fig. 9 is a photo-survey illustrating the labio-lingual, linguo-labial, and bucco-lingual views of the same denture shown in Fig. 8. It is a beautiful specimen of an end-to-end bite, the plaster cast of which Dr. J. Lowe Young was good enough to let me use for this occasion.

The next case (Figs. 10 to 21, inclusive) traces the work of a case under treatment. The legends under the illustrations are explanatory.

These figures are a reproduction of the actual surveys delivered to the orthodontist. They were mounted on cardboard, ordinarily they are combined in booklet form.

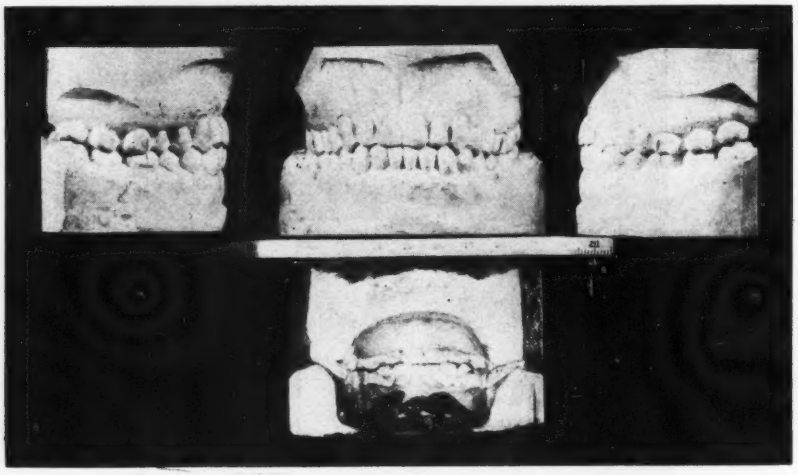


Fig. 9.

This case is interesting on account of the enormous tooth movements which had to be made. A supernumerary incisor (the most distal left lower incisor) was extracted. The consequence was a change in position of every tooth in the mouth.

The arches seem to have been swung bodily.. According to Figs. 20 and 21, Plates 7 and 8, the upper left and both lower halves were moved to the left while only the upper right bicuspids show a pronounced movement to the right on the survey.

It is evident that the entire remaining denture was not moved by an appliance anchored on the two bicuspids mentioned. It would be very much like having a horse try to pull the Vaterland up the Hudson river to her pier. Therefore, we must have another explanation.

The forces of malocclusion, acting muscular forces, etc., were balanced during the state of malocclusion (set malocclusion). Through the extraction of the supernumerary, the equilibrium was upset. Tooth movement set in, muscular and other forces performed their normal function in forcing the teeth

towards a new position of equilibrium, possibly into occlusion, and the orthodontist followed his calling by clearing the way of obstructions and gently guiding the teeth. Thus he cooperated with Nature.

The survey, if of any value in this investigation, must be a means of analyzing the case. The following analyses are offered:

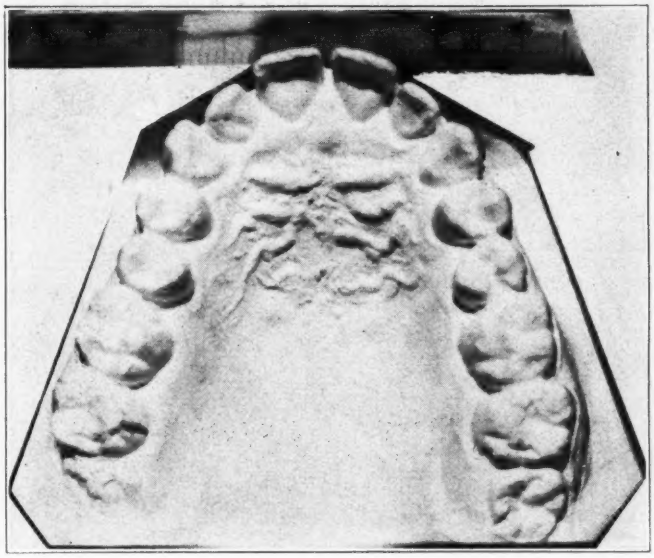


Fig. 10.—Plate 1. Photo-survey of upper jaw (A).

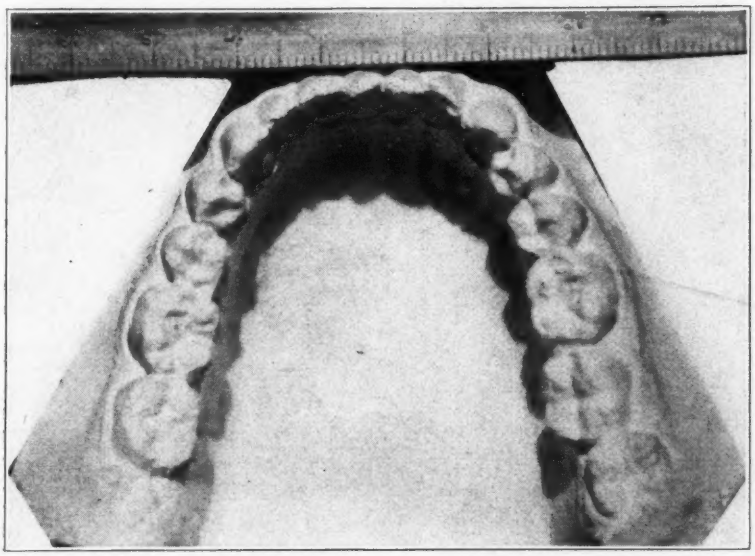


Fig. 11.—Plate 2. Photo-survey of lower jaw (B).

Individual teeth or small groups of teeth were pitched against the remaining denture, successively, a rather tedious job. In our case, however, it is not likely that such a course was followed (Figs. 20 and 21).

The photo-surveys, Plates 7 and 8 indicate that stress was applied to pull together the right and the left lower arches.

Five teeth on the left were probably pitched against nine on the opposite side. The right second molar acted as a quasi-pivot, even though it had not rigidly or pivotally been connected with the arch wire. The wire pressed lingually against the first molar, the bicuspids and the cuspid.

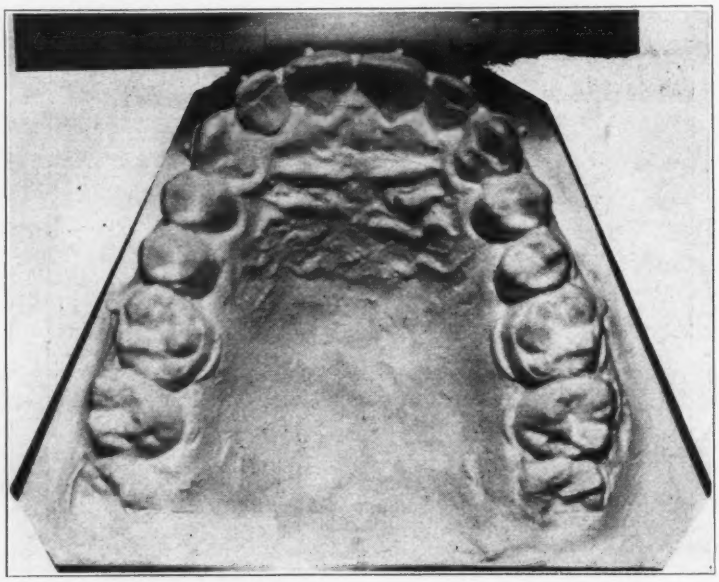


Fig. 12.—Plate 3. Photo-survey of upper jaw (C).

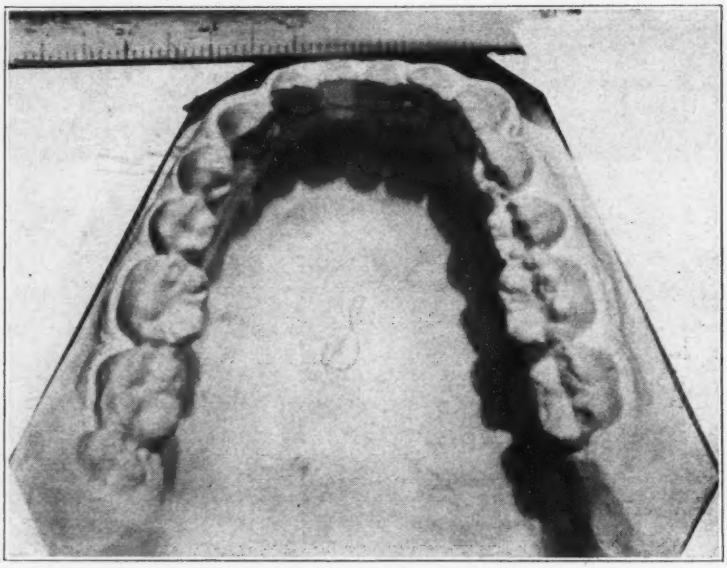


Fig. 13.—Plate 4. Photo-survey of lower jaw (D).

The anterior and posterior resultant forces terminated, say, in the third molar and the cuspid.

So far as transmission of forces within the arch is concerned, the cuspid was resting on the four incisors; the latter progressed in line towards the open space left by the extracted tooth, the remaining left was necessarily pulled to-

wards this very space, and was carried buccally. Strong intermaxillary forces acted in relining the right first molars and bicuspids. The upper centrals, as appears on the survey, were righted by swinging their roots labially. Con-

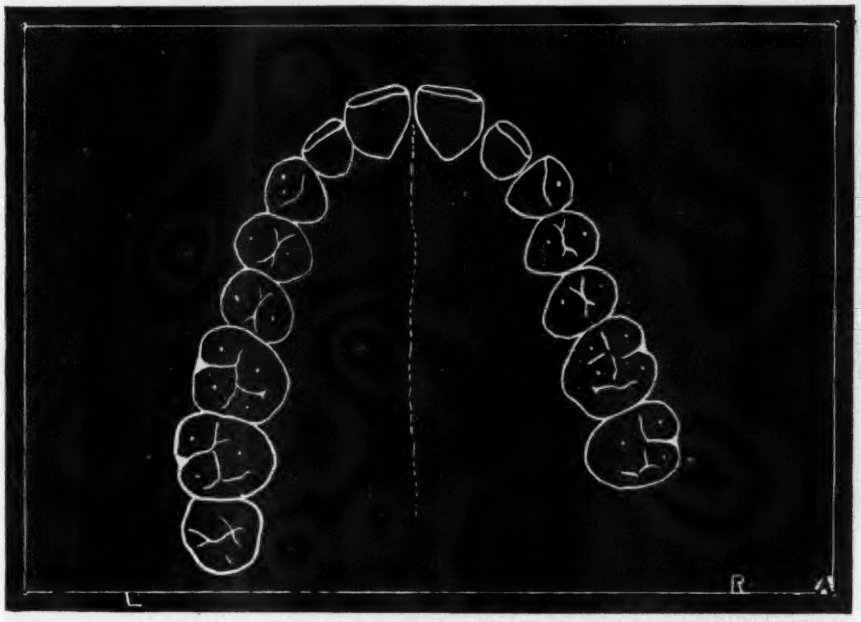


Fig. 14.—Plate 1 (A). Photo-survey of upper arch before treatment.

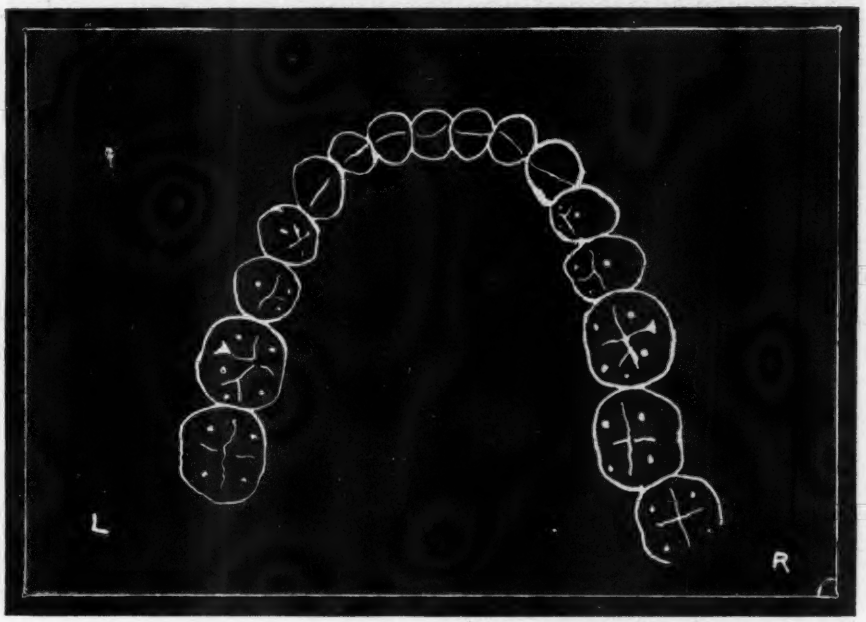


Fig. 15.—Plate 2 (B). Photo-survey of lower arch before treatment.

trary to this hypothesis is the observation that both the upper and the lower left cuspal region were carried labially. I am inclined to believe that the relation of the teeth shown on the survey is somewhat exaggerated; the new position of

the teeth being shown too far to the left. But, if the surveys are correct, strong forces, probably muscular forces, may account for such surprising movements.

It is of great importance to mention that all these tooth movements were reconstructed on the assumption that a molar can not be moved distally.

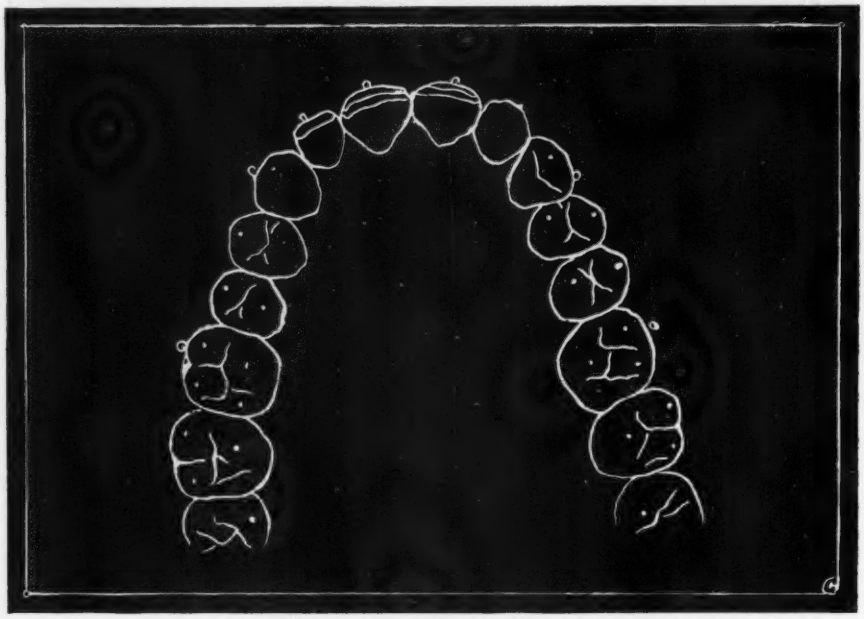


Fig. 16.—Plate 3 (C). Photo-survey of upper arch, supernumerary extracted.

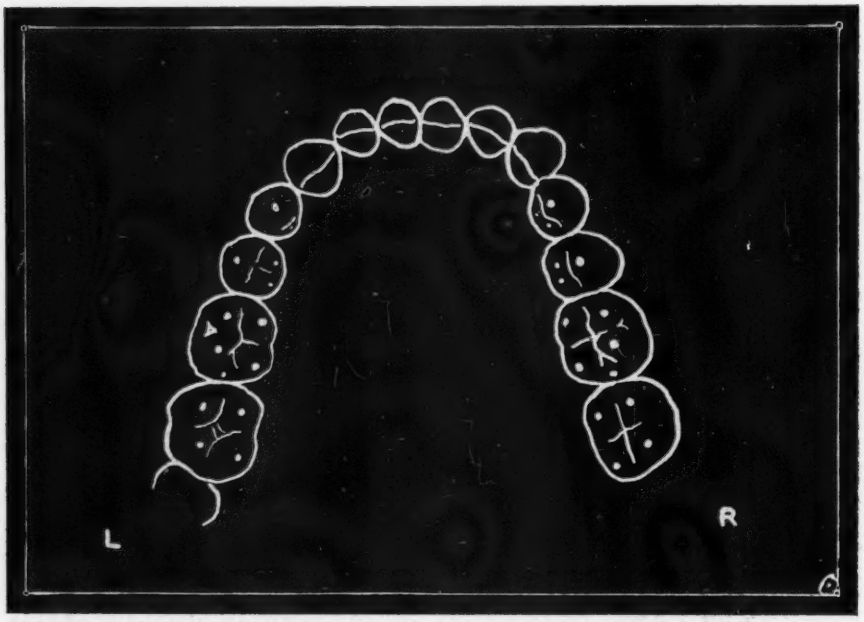


Fig. 17.—Plate 4 (D). Photo-survey of lower arch, supernumerary extracted.

During the early stages of my work, it was impressed upon me that it was advisable to reconstruct the arch, on the assumption of course, that it should be done with the least tooth movement. I have found, and hope to prove to you in the near future, that such a dogmatic rule is erroneous.

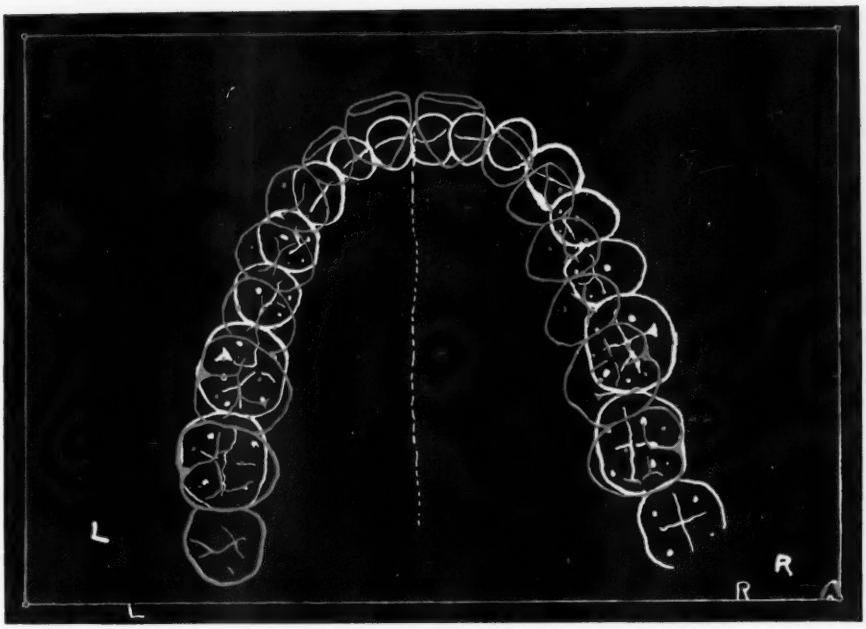


Fig. 18.—Plate 5. A and B in their occlusal relation. Plan view of the teeth in their malocclusal relation. Case before treatment.

Fig. 19.—Plate 6. C and D in occlusal relation. Plan view of the teeth in semiocclusal relation. Case under treatment.

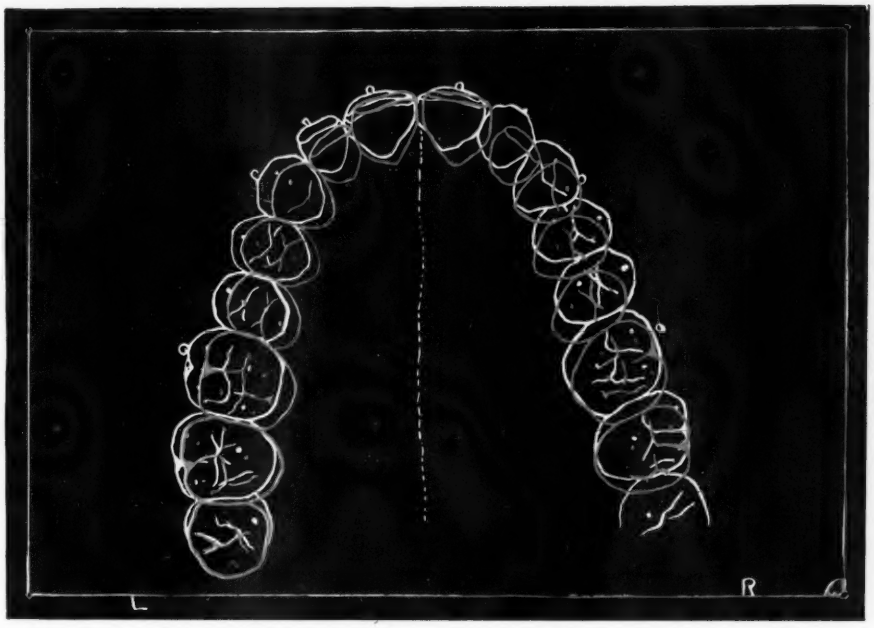


Fig. 20.—Plate 7. Plan view of upper arches (A and C) brought into relation to show change of position of the upper teeth.

Fig. 21.—Plate 8. Plan view of lower arches (B and D) brought into relation to show corresponding change in position of the lower teeth.

Either one of the analyses given, or a combination thereof, may be accepted as correct, *but that is not the issue. Through cooperation of the orthodontist and the dental engineer, the question could easily be settled.*

It was intended to show that photo-surveys are an aid to the orthodontist inasmuch as they represent valuable records which permit accurate research and offer a concise basis for discussion and interpretation of the orthodontists' aims and accomplishments.

DISCUSSION

Dr. W. A. McCarter, Topeka, Kansas.—Mr. Hanau has been working out for us, along mechanical engineering lines, a system of dental arch measurements and his photographs in connection with his work are very valuable. What I have to say will be about the method of taking photographs which I have used in my office merely for making records. Dr. Lischer suggested to us a few years ago the importance of keeping good records of our cases, and further suggested that the photographic method would be a perfect way of enabling us to do that. At one time, Dr. Dewey in a lecture showed front and side views of a patient in order to get an expression of the face, and a profile view, and I conceived the idea of combining the two and making profile and front view pictures at the same sitting. I have here a few slides illustrating this method. The work has been done entirely in the office. As I have a small operating room about ten by seven feet in dimensions, I try to condense everything, and I take the picture in two mirrors. Fig. 1 shows the interior view of the office.

Fig. 1.

Instead of taking one side of the face, I arrange a double mirror to get both sides of the face at the same time. In this corner, where the door leads into the operating room, I have attached a mirror to the door, and another mirror at a right angle on the wall. Two shaded lights are placed to reflect the light on either side of the face. The subject is seated on a stool in the angle between the two mirrors, facing the camera which is set about six feet from the mirror. Thus a picture is secured of a direct front view and both sides of the face at the same time.

Fig. 2 shows a picture taken with a double mirror. Sometimes there is a little difference in the two profile views of the patient. I take them both in one picture merely as a record.

In the same manner with the same mirrors a picture of the model is taken. By it is shown both right and left sides of the occlusion as well as the front (Fig. 3).

Mr. Hanau has shown us an illustration where he had a "multiview" picture. He took two separate pictures and put them together. By my method the same result is obtained with one exposure.

In taking pictures, Mr. Hanau has explained from a mechanical engineering standpoint that we have to have angles in a certain position. One of the mirrors which I used is fastened to the wall and the other is fastened to the door. I can change the focus of the reflected image, by increasing or diminishing the angle. With an angle of 45 degrees

Fig. 2.

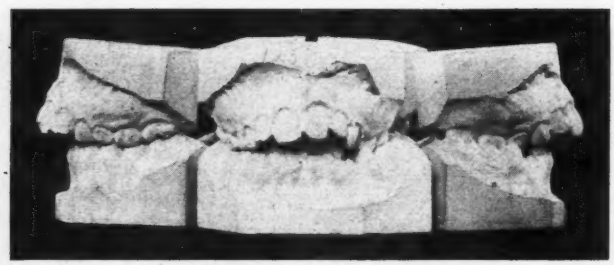


Fig. 3.

Fig. 4.

the profile reflection in the mirror is distorted, making it smaller than the front view. By having one of the mirrors on a hinge you can bring them closer together and get pictures of the same size.

Fig. 4 is a picture I showed last year at Pittsburgh. You may remember it. It was taken with two small mirrors, and a light camera. I think it was one of the Eastman kodaks, about No. 3-A. It is one of those things that is handy and can be set up anywhere and a picture taken with it.

I have shown you my system of taking pictures. It is a very simple and inexpensive way of keeping records.

Mr. Hanau.—The method Dr. McCarter employs is excellent for large objects and probably the most convenient, but it is limited in its accuracy, unless special provision is

made to compensate for the perspective. It must be kept in mind that the ordinary photograph is a perspective and that the side views are images, therefore, the right side view appears to be a left profile and vice versa. If it should ever be necessary to eliminate the latter defect, then I suggest that films instead of plates be used, and the film be reversed (that is, the side views only) when printed. As a relative record, I do not doubt that the pictures Dr. McCarter showed fully serve their purpose. I know that a photograph which ordinarily is a perspective is a rather inconvenient base from which to make absolute measurements and I have found it to be most unreliable and deceiving.*

Dr. R. Waldron, Newark, N. J.—In discussing this paper by Mr. Hanau which I did not receive until today I find it entirely different from its title and what I had expected it to be, therefore, I am not prepared to talk upon it as I would like to.

Mr. Hanau has shown us a photographic apparatus and has urged the importance of taking photographs of our cases for arch predetermination. Here I disagree with Mr. Hanau, for it is not necessary to have an engineer to compute all our cases, and when we do seek his services, he should make these orthographic projections of the models sent to him, for accuracy must be followed in every detail.

Mr. Hanau speaks of the superiority of the photographs as compared with the charts made with the surveying instrument. I purchased one of these surveying instruments and I am frank to say that I do not use it, for when I have a case which necessitates a survey I send my models to the engineer and let him use whatever method he pleases. All I am concerned in is his ideas of the solution of the problem, and then I am governed by my own judgment.

The question has been raised with reference to one type of arch. You know and I know that when we have a dental arch in malocclusion we can regulate the teeth to our satisfaction and to the satisfaction of the patient. Another man may take the same case and get a beautiful occlusion with a slightly different shaped arch by placing the teeth in a slightly different position.

As to the value of photographs of this work presented by Mr. Hanau, we have a great many doubting Thomases, but I am thoroughly convinced it has its place in the small minority of cases, for with the tooth material of one jaw harmonious in size with those of the other I believe these surveys are unnecessary.

Dr. Hawley had a case and very soon found out that he had an excessive amount of tooth material on the lower six anterior teeth. He extracted one of the lower laterals and obtained a beautiful occlusion. Later he sent his models to the dental engineer who suggested as one solution of the problem the extraction of that particular tooth which Dr. Hawley had removed.

As the other solution of the problem he recommended we have an end-to-end bite of the anterior teeth, and this you know was impossible as the forces which govern occlusion would be seriously interfered with, and therefore, we could not expect to preserve the integrity of the arch by so doing, for the normal over-bite has a great deal to do with the same and the normal approximal contact of the teeth would have been destroyed.

I have a case at the present time on which I have been working for two and a half years. The molars and bicuspids are in beautiful occlusion with sharp deep cusps, but I can not place the six lower anterior teeth in the arch and get occlusion. After measuring these teeth and spending considerable time in the study of this case I came to the conclusion that there is an excessive amount of tooth material in the lower six anterior teeth. The best way I thought to deal with this problem was to rotate the lower canines, which I did, and after doing so, I slightly rotated the laterals and then there was too much material, and I am sure that the only way in which to get occlusion is the removal of one of the lower teeth. I intend to send this case to Mr. Hanau and ask him which tooth he would extract to bring about the best results.

These cases are a very small percentage of those which we are called upon to regulate, and I think such cases should be sent to these men who style themselves dental engineers, but I do think it is a waste of time and money to send all our cases to these gentlemen when we can get results that are both satisfactory to ourselves and our patients without their cooperation.

Dr. B. W. Weinberger, New York City.—We are talking about extracting, where we have five incisors, a certain tooth, especially a lateral, to obtain occlusion. This model here (indicating) shows as nice an occlusion as I have ever seen. You will notice, of the five lower incisors, outside of the central one, there is no overlapping, and that one only a trifle. There are no means we can use to obtain a better occlusion than we have there.

*The reader is referred to the article, Multi-view-orthophotography, in the JOURNAL, iii, p. 142.

If we extract a tooth, what is the result? I have two cases in my own practice with five lower incisors that have "normal" occlusion, probably one of those types of cases where the upper tooth substance has been taken care of by Nature enlarging it to compensate for the lowers.

Mr. Hanau.—That is almost an end-to-end bite.

Dr. Weinberger.—Nature has compensated for that by decreasing the labio-lingual distance at the median line.

Dr. Waldron.—There is considerable depth to the bicuspids on this side.

Dr. Weinberger.—Yes, the molars as well, but those teeth are all in occlusion and articulation, on both sides.

Dr. Waldron.—There is considerable overlapping of the lower incisors.

Dr. Weinberger.—Very true, but only the center one. I would not extract a tooth like that. This is the skull of an Indian who was forty or fifty years of age. As you can see there is a pyorrheal condition, nevertheless, a majority of us wish we had as perfect an occlusion.

Dr. Waldron.—There was abnormality of the five incisors—an excessive amount of material.

Dr. Ray D. Robinson, Los Angeles, California.—It has been my experience that the teeth of one jaw do not harmonize with those of the other in size in but rare cases. I want to go further and say that the two lateral halves of the arches do not correspond in the measurement of the teeth. There is the greatest latitude there. I had one case where one central incisor was three millimeters wider than its mate. I can show you bicuspids from one to one and a half millimeters wider than the corresponding bicuspid on the other side. It is rather rare to find cases where the two lateral halves of the arch correspond in measurement. It is the great latitude which we have in the amount of over-bite that permits us to get anything like normal occlusion.

Dr. C. A. Hawley, Washington, D. C.—This work of Mr. Hanau's impresses upon our minds the fundamental conception of the relations of the teeth which Dr. Robinson has spoken of. If any man starts out with the idea that the teeth in the upper and lower jaws, or even the lateral halves of the same jaw are in absolutely accurate relation, if he takes measurements he would have that idea taken out of his head. All the variations Dr. Robinson spoke of occur. Some twelve years ago, I measured a good many teeth to establish the arch. I took a large number of measurements of the mesio-distal widths of different dentures from molar to molar and laid them out on a straight line one after the other, upper and lower, supposing, of course, there would be uniform variation in the length of the lines of the lower and lines of the upper, but there was nothing of the kind. I did not go any further to work out the amount of variation.

I am impressed very greatly with the value of Mr. Hanau's work, and especially when he lately shows that there are several arches in which teeth can be practically placed. When Dr. Stanton told us as the result of his investigation, that there was only one arch in which the teeth could be placed in proper occlusion, I think every man with experience hesitated to accept it.

I wish this matter could be simplified, and it seems to me it can be. The range of that variation which would influence our treatment occurs, if I understand Mr. Hanau rightly, anterior to the first bicuspid tooth; that is, it occurs in the front teeth. If we take the sum of the sizes of the upper and also add the sizes of the lower and then divide the lower by the upper, we get certain ratios which, together with consideration of the labio-lingual distances, will enable us to establish occlusal relation. A change of either factor must change the shape of the anterior curve.

I want to correct the impression that Dr. Waldron gave you in regard to that particular case. I did not work on the case for a long time before I reached a conclusion. This young lady came to me; she was twenty years of age, and I could see at a glance there was something unusual. I arrived at a conclusion in this way: I measured the upper six front teeth and laid the measurements down with a pencil on a curve; I drew on a piece of paper a curve I thought the arch ought to take. It was the curve of a Bonwill arch. I laid on that curve just the widths of the six anterior teeth; then I took the distance from the incisal edge of an incisor down one-third the lingual slope where the edges of the lower ought to be. I drew a curve of the lower teeth at that point and measured off the lower teeth on that line. I could see at once we could not get these four incisors in that curve. But I made another one and put in three, and that went in exactly. I extracted the lower incisor and obtained my result. I talked over the case with Dr. Waldron, and the case went to Mr. Hanau and his surveys corroborated the result. I exam-

ined two models belonging to a friend of mine, an orthodontist, who was struggling over these cases. He had been treating them some time and could not get an overbite. We went over them in the same way, and I decided that the only way to get a normal overbite was to extract a lower incisor. He did not do it. He thought that these teeth were exactly proportionate, but he never secured good occlusion. To treat my case and get an end-to-end overbite would have been foolish. You can not do that sort of thing. You could not do it for this lady without producing a disproportion in her features which would not be permitted.

I had another case which Dr. Waldron spoke of in which the reverse condition occurred. This case had been treated a long time. I had too much tooth material in the upper jaw. Mr. Hanau surveyed and corroborated the condition. I wish there were five lower incisors in this case, but they are not there, so I started to move the six anterior teeth forward and leave a little space between the lower first bicuspids and cuspids. In that way I can get a normal overbite and normal occlusion.

Mr. R. Hanau.—Dr. Waldron very correctly stated that it is unnecessary to survey every case. It was not my intention to convey the idea that it would be necessary; however, I wish to urge you to study and understand surveys, not only as such, but as a means of investigation and planning. You may then foresee the changes in occlusal relation for certain changes in the arrangement of the tooth units or groups. For instance, you will be able to solve the problem of how to produce a more pointed or blunt arch form (change of the compensating contact curves) by changing the relation of the teeth in one or both jaws; also how to overcome defects in the occlusal relation about the cuspids or any other part of the denture.

I realize the course I suggest seems a difficult one, inasmuch as it involves descriptive geometry which is not included in the curriculum of dentistry or medicine, and is not particularly attractive to those who did not have the occasion or time to familiarize themselves with the subject. Nevertheless, I believe I may presume that upon studying descriptive geometry, you shall soon know more about it than I do about orthodontics. I assure you, you need geometry more than I do orthodontics! Why? As orthodontists, what are you doing? Simply performing engineering work in small space; and, one of the main axioms of engineering is descriptive geometry.

I wish you would give this subject more serious consideration. I believe it shall be to our mutual advantage. It would stimulate further investigation and no doubt lead to some very valuable results.

I greatly appreciate your attention and heartily thank you for the interest taken in this subject.

THE INDIRECT METHOD OF ANCHOR BAND CONSTRUCTION*

By Martin Dewey, M.D., D.D.S., Chicago

IN giving to you the indirect technic of making bands for orthodontic purposes, I do so because it is my belief that in a large number of instances a more accurately fitting band can be made and be made with much greater ease to the patient by the indirect method than if made directly over the tooth. I am aware that there are a great many operators who can make bands directly over the teeth which fit very nicely and which are perfectly satisfactory both to the operator and to the patient. Nevertheless, the fact remains that those bands which appear to be perfect if placed upon a metal model of the same tooth could be more accurately fitted by being swaged according to the indirect method than they fit when made directly over the tooth and contoured and burnished. It is a well-known fact that any piece of metal can be more easily adapted to a surface by being swaged than it can by being burnished.

You are also more or less familiar with the arguments which have been going on among dentists in regard to the advisability of making inlays by the direct or indirect method and each plan has a large number of advocates. However, everything considered, I believe that a more accurate adaptation can be made by the indirect technic in orthodontic work, especially the bands on molars and premolars, than can be obtained by making the band directly over the tooth. The methods which I give to you today are by no means original to me as I obtained them from conversation with and observation of other men. In making bands according to the indirect method we have the band technic which has been described by Dr. Mershon where the band is made over the plaster tooth. This method has been previously described in the Journal.

Today I will confine myself to the swaging of bands over metal models and give you two plans of obtaining the model by the indirect method for your consideration. These plans differ in that one uses a modeling compound impression with an amalgam model, while the other uses a plaster impression with a Melotte model. In taking a plaster impression for making a band by the indirect method as described to me by Dr. Schroeder we use a tray for the purpose of obtaining an impression only of the tooth that is to be banded and the approximating teeth. Before taking an impression of the tooth that is to be banded we slip two pieces of metal between the approximating teeth and then take the impression in plaster. The impression on the right of Fig. 1 shows the impression as it is removed from the mouth with the strips of band material in between the teeth. As we desire a model only of the tooth to be banded, the impression of the approximating teeth is filled in with moldine as is shown at the left of Fig. 1. If we desire to increase the length of the tooth, it can be accomplished by carefully building a rim of moldine around the gingi-

*Read before the Seventeenth Annual Meeting of the American Society of Orthodontists, Excelsior Springs, Mo., Sept. 7, 1917.

Fig. 1.—Impression for indirect band-making, showing pieces of metal between teeth and approximating teeth filled with moldine. (Schroeder.)

Fig. 2.—Metal models of single teeth. Models of anterior teeth made with strip of metal between teeth. (Schroeder.)

Fig. 3.—Thin copper band trimmed to festoon of gum.

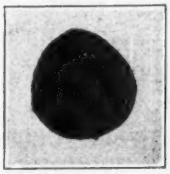


Fig. 4.—Impression of tooth in compound.

Fig. 5.—Impression with celluloid strip wrapped around it.

Fig. 7.—Copper amalgam model of tooth.

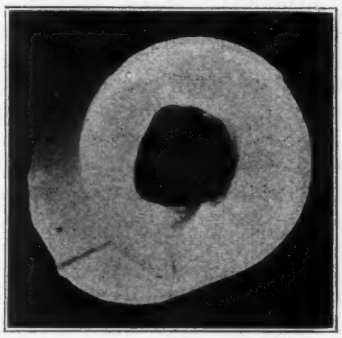


Fig. 6.—Impression invested in plaster.

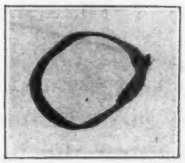


Fig. 8.—Band soldered with lap joint.

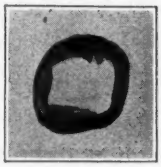


Fig. 9.—Band swedged.

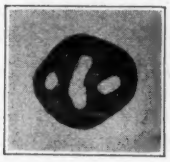


Fig. 10.—Band with cusp soldered and cut out for occlusion.

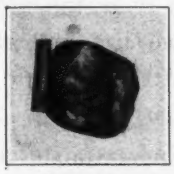


Fig. 11.—Crown with tube and lug.

Note: Figs. 3-11 were supplied by Dr. W. A. Coston, of Topeka, Kansas.

val border of the impression which will increase the length of the tooth and enable us to fit the band much more accurately around the gingival margin of the tooth than we would if the gingival gum tissue were reproduced in metal. After the impression has been packed with moldine, the model is made from Melotte's or Babbitt's metal, which is shown in Fig. 2.

A wire measurement is then taken of the metal tooth. A piece of band material the proper length is cut, which can be swaged and adapted to the metal tooth. This swaging can be accomplished by a horn mallet or can be accomplished by placing the tooth and the band in a small plunger's swager such as used for crowns and bridges. If it is desired to make bands upon the anterior teeth, an impression can be taken of them in the same way as an impression was taken of the molars with pieces of band material placed between the teeth (Fig. 2). If pieces of band material are placed between all the anterior teeth, it will be possible to obtain a metal model of the six anterior teeth upon which bands can be fitted.

Another method of making bands over metal models is described by Dr. Coston and I will only outline his technic briefly as he is here to speak for himself. According to this plan a copper band is made for the tooth, trimmed and festooned so as not to injure the gum (Fig. 3). This band need only fit approximately as it is to be used as an impression tray to carry the modeling compound which is to take the impression of the tooth. Fig. 4 shows the impression of the tooth in modeling compound. As we are going to make an amalgam model of a tooth and desire a sufficient length of the metal tooth to be convenient for handling, a strip of celluloid is wrapped around the tooth or the impression of the tooth as is shown in Fig. 5. The impression is then invested in a plaster investing ring as shown in Fig. 6. After the impression is hard, the modeling compound impression as invested in the plaster ring is packed full of copper amalgam, which gives a copper tooth as shown in Fig. 7.

A piece of band material is then cut to fit around the tooth, and is generally cut with the ends on the bias. The end of the band can be soldered, either pinched or lapped, but a lapped band is preferable in the swaging process (Fig 8). The band is placed upon the metal tooth and the same placed in a swage and swaged, which results in the bands being properly adjusted and adapted to the tooth (Fig. 9). This plan of swaging bands is especially desirable on deciduous molars because a much more accurate fit can be obtained and because the bands can also be made with less pain and less annoyance to the patient than if made directly in the mouth. In some cases where the molars are short or the crowns are faultily calcified, it may be desirable to swage a cusp over the metal tooth for the purpose of making a band which has an occlusal surface. If this occlusal surface of the band interferes with the occlusion after the band has been cemented on, it can be cut out with a stone as shown in Fig. 10.

Such attachments as are necessary can be made on the band as shown in Fig. 11, including a buccal tube on the buccal surface of the band. It will also be observed that there is a small tube soldered on the lingual side which is for convenience in removal of the band. The swaged band fits so accurately that

it is difficult to remove it from the tooth if the band is tried on before being cemented. The spur is soldered on for the purpose of assisting in the removal of the band during the period the appliances are being fitted. I have found that these bands fit much more accurately than any band which I have ever observed, and we believe that the accuracy can only be appreciated by those who try them and use them in their practice.

DISCUSSION

Dr. W. A. Coston, Topeka.—I do not know that it is possible for me to add anything to what Dr. Dewey has said in regard to the making of these bands. I have had a great deal of comfort and pleasure myself in making them by the indirect method, as we have had in the general practice of dentistry a great deal of comfort and benefit in the making of all restorations by the indirect method. It almost goes without saying that the making of anything to be cemented in the month, or to be set in, that is removable in any way, can be made more definitely by the indirect method than by the direct method. Of course, many years ago we applied the indirect method in the making of all artificial dentures. We think a man is probably an extremist who would claim he can adjust a plate to the mucosa as easily as he could to a plaster or a metal model, and while it may be an unfair comparison, it is to a degree true of anything we make in the way of restorations in the mouth, and equally true in making anchor bands in orthodontia, provided one feels that accuracy of fit is desirable. We know it is true that all sorts of plain bands are adapted, after a fashion, to teeth in this work, and they seem to accomplish what we desire of them; but on account of the occlusal constriction of teeth, which is so noticeable in temporary molars, it is practically a physical impossibility to ever adapt a band to teeth properly and closely.

The use of copper amalgam in the making of the model is purely for economic reasons. Any amalgam would do as well. In my experience there is no comparison in the accuracy of a model made by pouring metal, or casting, and one made by forcing amalgam into a matrix. The impression is made by taking a copper band that is made in twenty sizes, and from one-third to one-half of an inch long, very thin. They can easily be adapted to the teeth loosely. Cut away the band on the approximal surfaces to accommodate the gingivæ, and make very thin approximately, and then fill with modeling compound. After being softened with heat, the band filled with compound is forced to place. The compound is confined by the band, and you get a very accurate impression of the tooth all the way to the gum line. The modeling compound is confined and can not get away, and you can make as good an impression or better than you can make with plaster of Paris, probably. It is invested in plaster of Paris so that you have a receptacle into which you may pack your amalgam with a good deal of force, and the copper amalgam is made thin and packed in place. The result is practically a perfect model of the tooth upon which you can fit any band with more accuracy than you can fit it in the mouth. You can make them very thin so that, as Dr. Dewey says, they slip on the teeth and go quickly to place. When made of heavy material, it affords the possibility of having the band so accurately fitted that in a child's mouth it goes to place without any trouble, without any pain, and without wounding the investing tissues.

At the clinic I will show you the method very much better than I can possibly explain it to you.

Dr. C. A. Hawley, Washington.—I do not know that I am in a position to discuss this paper. I did not see it before it was read. My impression is that this technic is altogether unnecessary. So far as fitting bands in the mouth is concerned, I can put bands directly in the mouth, while they are getting the material ready. So far as fitting them in a child's mouth or anybody's else mouth, where the proper separation is made beforehand, I do not see any reason whatever for using the indirect method for that purpose. I have a young man in my laboratory who makes them first on a plaster model. I use plaster, and you can make a plaster model in one-fourth of the time, and there are very few that do not fit in the mouth. If they do not fit to suit me, as they are made of iridio-platinum, soldered with pure gold, I can open and change them while you are pouring one of these indirect models of metal.

So far as time saving is concerned, I do not see any advantage in it either for the laboratory man or the man at the chair.

I do not know that I have anything more to say other than to call your attention to what I presented last year in a paper I read at Pittsburgh. I have not seen any of these bands, but you can not make metal models either of amalgam or any metal without stretching the band, and it does not fit better than I fit them in the mouth in one-quarter of the time. So far as an absolute fit being hard to remove, I have fitted many bands in the mouth that any one would have hard work to pull off. I have broken many an excavator trying to pull them off when fitted directly in the mouth.

Dr. Coston.—Of course, we know that bands can be crimped in under the gums many times so that they will stay there for an indefinite time, and very many times to the detriment of the investing tissues, and the only contention I have is making bands that fit with reasonable accuracy which protect the soft tissues, enabling one also to make a band that does not interfere in any way with the occlusion, which is impossible with a straight band because the constriction is so great that crimping in of the band over such a tooth leaves fissures and wrinkles, while by the swaging process there are no wrinkles. They can be made to fit so that they work all right, just as we do many things that work all right.

Dr. Fisher.—How long a time do you allow for making an amalgam model before you let your laboratory man work on that model?

Dr. Coston.—Copper amalgam takes six or eight hours to crystallize.

Dr. Fisher.—You would not have to do it the next day?

Dr. Coston.—No. I have my laboratory man make it so that it will fit, and whether I put my bands on today or tomorrow is not a matter of great importance.

Dr. Manly Bowles, Winnipeg.—The method I use is as follows: I make an overlapping clamp band, in some cases the ordinary clamp band that you may purchase will do, fit it on the tooth, burnish it, and remove. Then solder together the overlapping ends, at the same time removing the clamp. Frequently, however, in the ordinary clamp band we find that where the clamp is soldered to the band it is flattened and widened to such an extent that it is hard to burnish the band to the tooth. I then make a clamp band having the screw portion of the clamp bent sharply at right angles and not flattened. With children I take an impression in modeling compound, obtain a cast in hard plaster, and trim as described by previous speakers. I then fit and burnish my band to this model. I am not worried if the model is not absolutely accurate as the final tightening and burnishing of the band will be done in the mouth.

INCOME TAX INFORMATION FOR DENTISTS*

By Clarence O. Simpson, M.D., D.D.S., St. Louis, Mo.

THE Income Tax Act of 1917, levying on all incomes over $2,000, and those of the unmarried over $1,000, will apply to many professional men not affected by former income tax laws. There being certain distinctive factors to consider in computing the net income of dentists, the following general information and special interpretation was obtained from the collector of internal revenue to aid the profession in making returns.

GENERAL INSTRUCTIONS

If you are married and live with your wife (or husband) and your net income for 1917 equaled or exceeded $2,000, you must make a return. If you are not married, are not the head of a family (actually supporting one or more individuals closely related by blood, marriage, or adoption), or not living with your wife (or husband) and your net income for 1917 equaled or exceeded $1,000, you must make a return. Send the return to the collector of internal revenue for the district in which you live so that it will reach him on or before March 31, 1918. The address of the collector of internal revenue and the form which must be used for the return may be secured from any post office or bank.

PENALTIES

The maximum penalty for failing to make return before specified time, is a fine of $1,000 and in addition 50% of the amount of tax due. For making false or fraudulent return, a fine of $2,000, one year's imprisonment, and in addition 100% of the tax evaded. For failing to pay the tax when due, 5% of the amount unpaid, plus 1 per cent interest for each month during which it remains unpaid. All provisions of the act will be rigidly enforced, no excuses will be accepted, and the lax methods permitted in the making of personal and realty tax returns will not be tolerated.

AMOUNT OF TAX

Unmarried persons must pay 2% on net income over $1,000, and 2% additional on all over $3,000. Married persons or heads of families must pay 2% on net income over $2,000, and 2% additional on all over $4,000, less an exemption of $200 for each dependent child under 18 years of age. In addition a surtax of 1% must be paid on income over $5,000, 2% over $7,500, and 3% over $10,000. There is an increasing rate up to $2,000,000, but any exclusive dentist with a five figure income should not waste his valuable time or risk his mental poise by sordid calculation, and any "popular price," general practitioner who has "speeded up" to more than $10,000 need not worry about income tax, the administrator will attend to this along with the other details in closing the estate.

*Excerpt from the President's address read before the St. Louis Dental Society, Jan. 8, 1918.

EXAMPLES OF APPLICATION

Unmarried with	$1,400	income	Unmarried with	$4,600	income
Exemption	1,000		Exemption	1,000	
2% on	400 =	8.	2% on	3,600 =	72
Total tax		8.	2% on (over $3,000)	1,600 =	32
			Total tax		104
Married with	$2,400	income	Married with two children and income of	$5,600	
Exemption	2,000		Exemption	2,400	
2% on	400 =	8.			
Total tax		8.	2% on	3,200 =	64
			2% on (over $4,400)	1,200 =	24
			1% on (surtax)	600 =	6
			Total tax		94

FACTORS IN DETERMINING INCOME

The gross income from a dental practice is the total receipts during the calendar year of 1917, unpaid accounts whether collectable or not should be omitted. The net income is the total receipts, less the expenses of conducting practice during 1917.

EXPENDITURES ADMISSIBLE

The following items are considered legitimate expenses of conducting practice:

Office rent.

Heat, light, water, and janitor service. (Unless included in rent.)

Assistants.

Materials, including precious metals and all supplies, except equipment and appliances serviceable for more than a year.

Laundry.

Insurance. (Fire, tornado, and liability, only.)

Dental society dues, expense, and contributions.

Necessary expenses in attending dental meetings.

Cost of postgraduate courses during 1917.

Dental journals.

Cost of collecting accounts of 1917.

Interest on notes for equipment.

Taxes paid on equipment, furniture, and supplies in 1917, except special assessments for local improvements.

Depreciation of office equipment, furniture, instruments, appliances, and scientific library. (This includes some articles serviceable for a long period and others which from wear or subsequent improvements must be frequently replaced, and 25% of the cost is permissible.)

Losses by fire, storm, or theft, not covered by insurance.

EXPENDITURES NOT ADMISSIBLE

The following are items which have been, or might be, considered as expenses of conducting practice, but are *not* so construed in the provisions of this act:

Interest on investment.

Interest on the cost of professional education.

Refund on investment.

Salary or expenses of self or family.

Accident, health, or life insurance.

Cost of equipment purchased during the year. (Deduct only for depreciation.)

Uncollected accounts. (Should not be included in gross income or deducted.)

These instructions apply only to the income derived from practice, and income from colleges, postgraduate instruction, appliances, patents, books, stocks, bonds, property, notes, mortgages, bank deposits, or other sources must be included under the proper heading.

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EDITORIALS

Service Versus Results—A Question of Orthodontic Fees

ONE of the most difficult problems confronting the man taking up orthodontia as a specialty is the question of arranging the fees. We realize that a great deal of space has been given to the question of dental fees by writers upon the subject of business as related to dentistry, but many of these articles have not been satisfactory from the point of every one concerned because they have failed to reach the real basis for naming the fee. Many plans and methods have been adopted, but the majority have not been satisfactory to both the patient and the operator.

Orthodontics, as well as any branch in medicine, is based upon the service rendered the patient, and surely the fee should also be charged on this basis. Consider for an instant the average orthodontist who undertakes the treatment of a case of malocclusion. He is very often obliged to promise the patient a

certain definite result; he bases his fee on that promised result and charges for the length of time that will be spent in the correction of the case and what the correction will be worth to the patient in the end. Both of these factors should be considered, but the real solution of the problem is that the patient should pay for the service rendered. Then, if the question of what that service is worth to the patient, comes up, one has a perfectly logical proposition upon which to work.

We have known of a number of cases of malocclusion in which treatment was attempted and satisfactory results never obtained because the patient continued traveling from one place to another during the time of the treatment. The operator has spent considerable time and energy and still has not accomplished the same results as he would have if the patient had stayed under his treatment; however, the patient has been greatly benefited. There are cases in which the patient refuses to follow the instructions of the orthodontist, fails to keep appointments, and consequently limits the results, nevertheless, the orthodontist expends as much energy or more than if he had the cooperation of the patient. We also find malocclusions in which it is possible to obtain a practical result, but, owing to the deformation of some teeth—the improper size or improper cusp development—an ideal and normal occlusion will never be accomplished. If the orthodontist has been so short-sighted as to promise a normal occlusion in such a case, it will be impossible for him to accomplish that result; however, the result which he may obtain will be a practical occlusion, one which, from the standpoint of service, will probably render 95 per cent efficiency and be nearly as satisfactory as if the teeth were absolutely ideal and normal. In such cases as these mentioned, if the fee has been based upon the service rendered, there can be no argument, because a valuable service has been rendered, and all that possibly could be obtained under the existing conditions has been given. It must be remembered in the correction of any case of malocclusion that the improvement of the condition of the teeth is a valuable service rendered for which the orthodontist should be paid, even though conditions are present which made the establishment of normal occlusion impossible.

We believe that a great many orthodontists have handicapped themselves and placed themselves to a disadvantage professionally by promising a definite result to a patient, which in the majority of cases can be accomplished, but which in some instances, owing to conditions over which the orthodontist has no control and which can not be foreseen until treatment is commenced, will never be satisfactory to the operator from the standpoint of his ideal.

We, therefore, believe the solution of this problem is for the orthodontist to base his fee upon the service rendered the patient, instead of upon a promised result, which in some cases can not be obtained.

The Universal Regulating Appliance

WE have often called attention to the fact that there are those in the practice of orthodontia who try to find or design a regulating appliance capable of correcting all types of malocclusions, and some designers have placed on the market appliances for which they make this claim, as well as to state that they require little attention from the operator. Most of these appliances

so designed have been advertised by manufacturers, and as the sale of the appliance necessarily increases the income of the designers, we are often led to wonder if some of the assertions made are even believed by these men themselves.

The practice of orthodontia has been retarded many years by attempts to force upon the profession certain styles of appliances or to confine the practice of orthodontia to the use of some particular kind or style of appliance. This practice will place orthodontia in the same stage that medicine was when one drug was considered for treatment of all human ills. While it is true that malocclusions can be classified and placed in a few groups, it is equally true that their correction often requires very different treatment and styles of appliances. An appliance may be satisfactory for a case if used on the patient at the age of seven, but will not be suitable for the same case at the age of seventeen. In other words, conditions change even in the mouth of the same patient, and make the use of an appliance possible at one time and impossible at another. Only recently a new appliance has appeared and been widely advertised, the principal feature of which is that it may be put on and it does the work unaided. If every tooth moved exactly the same and every case required the same amount and degree of force, there might be some possibility of designing an appliance that would work satisfactorily in all cases of malocclusion without any attention on part of the operator. Malocclusions differ a great deal, and even those that appear to be similar require different degrees of force to produce movement in different individuals. We even find similar teeth in the same mouth that do not move with the same degree of rapidity. For these reasons designing a universal appliance and placing it before the public with the statement that it will do the work is at least misleading to a great many men.

We find that the appliances that do the work without any attention are also being advertised in a different manner. For several months past one of the dental journals has been publishing a series of articles dealing with a plan of diagnosis and methods of treatment. These articles have been followed up by advertisements indicating that if the methods advocated are followed, after the appliance is properly constructed, it can be placed on the teeth and with very little assistance will successfully treat the case. In other words, the authors of these methods and the constructers of these appliances would have the dental profession believe that if the plans laid down were followed, any one, regardless of his knowledge of orthodontics, could successfully treat a case of malocclusion. We do not attempt to decry the value of these widely advertised styles of appliances or the use of certain methods and plans of diagnosis, for all of them have a value; but we do believe it is misleading to send out the information that an appliance, if properly placed upon the teeth, will do the work without care and assistance on the part of the operator. Even if the appliance is properly constructed and placed on a model, it must be carefully transferred from that model and placed upon the teeth in the same position in order to accomplish anything like successful results.

The possibility of any regulating appliance automatically correcting a malocclusion is destroyed by the complications that present in the different resistances to tooth movement as well as different degrees of development, etc.

One of the most necessary things in the successful treatment of any malocclusion is the selection of the proper appliance, and this can only be made after careful study of the case and the principles of appliances. Therefore, we would recommend that an appliance be chosen because of its mechanical fitness for the particular case, and not because of some high-sounding advertisement of a manufacturer.

The Fifth Annual Meeting of the Pacific Coast Society of Orthodontists

ON Monday and Tuesday, February 18 and 19, 1918, the Pacific Coast Society of Orthodontists will hold their Fifth Annual Meeting at the Palace Hotel, San Francisco, California. The following program has been arranged:

Monday, February 18.

9:30 President's Address.
William Cavanagh, Portland, Ore.

Discussion opened by:
James D. McCoy, Los Angeles.

The Third Molar Influence on Orthodontic Cases.
H. L. Morehouse, Spokane.

Discussion opened by:
Robert Dunn, San Francisco.

A System of Orthodontic Records.
C. O. Engstrom, Sacramento.

Discussion opened by:
John R. McCoy, Los Angeles.

1:30 Natural Tooth Movement During Performance of Function.
Nye White Goodman, Los Angeles.

Discussion opened by:
Leland E. Carter, San Francisco.

Clinic.
D. Arthur Johnston, Los Angeles.
Frank E. Sarp, Los Angeles.
Some Suggestions as to Prophylaxis During Orthodontic Treatment.

3:00 Annual business session.

Tuesday, February 19.

9:30 Orthodontia in the Year 1918.
B. Frank Gray, Colorado Springs.

Discussion opened by:
William B. Powers, Seattle.

Dentistry for All the People.
Allen Suggett, San Francisco.

Discussion opened by:
A. W. Sobey, San Francisco.

Our Moral Responsibility.
Charles C. Mann, Seattle.

Discussion opened by:
W. R. Dinham, Portland.

1:30 *Clinics.*

C. O. Engstrom, Sacramento.
A Band Ring.

James D. McCoy, Los Angeles.
Appliances for the Bodily Movement of the Teeth.

W. R. Dinham, Portland.
(Subject to be announced.)

A. A. Solley, San Francisco.
Fractures of the Maxillæ.

Leland Carter, San Francisco.
Removable Orthodontic Appliances.

John R. McCoy, Los Angeles.
A Technic for the Construction of Plain Molar Bands.

Robert Dunn, San Francisco.
(Subject to be announced.)

William B. Powers, Seattle.
(Subject to be announced.)

Officers and Standing Committees for 1917-1918 are as follows: *President,* Dr. William Cavanagh, 808 Corbett Building, Portland; *Secretary-Treasurer,* Dr. John R. McCoy, 908 Brockman Building, Los Angeles; *Program Committee,* Dr. H. F. Sturdevant, Chairman, Dr. James D. McCoy, Dr. Allen Suggett; *Membership Committee,* Dr. Robert Dunn, Chairman, Dr. C. O. Engstrom, Dr. William B. Power.

Dr. George D. Kennedy

THE death of Dr. George D. Kennedy at his home in Colorado Springs, January 27, is sad news to his many friends in various parts of the United States. Dr. Kennedy occupied a high place in the dental profession and was well respected by the citizens of his city. He had been ill for over three years and it was hoped at times that he would eventually recover, but an All-wise Ruler deemed that he should remain with us only in spirit.

Dr. Kennedy was born in Centralia, Illinois, September 27, 1868. He graduated from the Washington University in 1891 with honors, being the youngest man in the class. He was married to Miss Bessie Linn in 1898.

He was a prominent Mason, a Past Master of El Paso Lodge No. 13 and Past Grand Master of the Colorado Grand Lodge. In 1913 he took the course in the Dewey School of Orthodontia. He passed the California State Board and intended to practice orthodontia in California, but owing to failing health he returned to Colorado. He is survived by his wife, mother, sister, brother, and foster daughter.

Dr. Kennedy was an exceptional student, and we feel that besides his death being the loss of a friend, the science of orthodontics has lost one of the brightest men that ever took up the work.

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